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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant : Walter Blum, et al.  
Serial No. : 10/584,226 / Conf. No. 9147  
Filing Date : June 23, 2006  
Examiner / Group Art Unit : Patricia L. Nordmeyer / 1794  
Title : SEALING TAPE FOR ADHESIVE  
BONDING OF VAPOUR BARRIER  
FILMS AND VAPOUR RETARDER  
FILMS, AND PROCESS FOR ITS  
MANUFACTURE  
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**APPEAL BRIEF**

Dear Sir:

This brief is in furtherance of the Notice of Appeal filed in this case on November 11, 2009 and received by the United States Patent and Trademark Office on November 16, 2009.

Enclosed is a Credit Card Payment Form authorizing a large entity charge of \$540.00 to cover the fee for filing the brief in support of the appeal. Please charge any additional fees which may be required for this matter to Applicant's attorney's Deposit

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Real Party in Interest

The real party in interest is Lohmann GmbH & Co. KG, the assignee of record. An assignment from the inventors to Lohmann GmbH & Co. KG was recorded at the United States Patent and Trademark Office on January 19, 2007, at reel 018786, frame 0165.

Related Appeals and Interferences

None.

Status of Claims:

Claims 1-16 are pending in the application. Claims 12 and 13 are withdrawn. Claims 1-4, 6-11 and 14-16 stand as rejected as allegedly being unpatentable under 35 U.S.C. §103(a). Claim 5 stands as rejected as allegedly being unpatentable under 35 U.S.C. §103(a). The rejection of claims 1-11 and 14-16 is being appealed.

Status of Amendments:

No further amendments have been filed subsequent to the Final Office Action which is dated June 11, 2009.

### Summary of Claimed Subject Matter:

The present invention relates to a self-adhesive, flexible sealing tape (page 2, line 10; paragraph 00002; claim 1). The self-adhesive, flexible sealing tape comprises at least one flexible, self-adhesive core/carrier layer (page 2, line 11; page 3, lines 2-3; paragraphs 00002, 000013; claim 1) which is provided with an envelope / two-sided coating (page 2, line 11; page 3, line 3; paragraphs 00002, 000013; claim 1) comprising a second adhesive system (page 2, lines 11-12; page 3, line 4; paragraphs 00002, 000013; claim 1). The envelope / two-sided coating comprises an expanded pressure-sensitive adhesive tape (page 3, lines 33-34; paragraph 000019; claim 1). The envelope / two-sided coating completely surrounds/encloses the at least one core/carrier layer (page 2, lines 10-12; paragraph 00002; claim 1). The material for the at least one core / carrier layer is selected from the group comprising thermoplastic rubbers on the basis of styrene-isoprene-styrene block copolymers, styrene-butadiene-styrene block copolymers, copolymers of vinyl acetate, polyisobutylenes and acrylates which have been cross-linked by a process selected from the group consisting of thermally and UV irradiation (page 3, lines 15-20; paragraph 000014; claim 1). The material for the core / carrier layer has a glass transition temperature ( $T_g$ ) of below 0 °C (page 3, lines 19-20; paragraph 000014; claim 2).

The pressure-sensitive adhesive tape is based on a pure dispersion acrylate (page 3, line 34; paragraph 000019; claim 3). The pure dispersion acrylate is based on plasticizing monomers selected from the group consisting of 2-ethylhexyl acrylate, 1-butyl acrylate and n-butyl acrylate (page 4, lines 1-3; paragraph 000020; claim 4). The pressure-sensitive adhesive tape comprises an adhesive based on a material selected from

the group consisting of vinyl isobutyl ether and isobutene (page 4, lines 3-5; paragraph 000020; claim 5). The thickness of the core/the carrier layer is between 0.1 mm and 8 mm (page 3, lines 21-22; paragraph 000015; claim 6), or further between 1 mm and 5 mm (page 3, lines 21-22; paragraph 000015; claim 15). The width of the core/the carrier layer is between 1 mm and 10 mm (page 3, lines 22-23; paragraph 000015; claim 7). The thickness of the envelope/two-sided coating is between 0.2 and 1.5 mm (page 4, lines 15-16; paragraph 000022; claim 8), or further between 0.5 mm and 1 mm (page 4, lines 15-16; paragraph 000022; claim 16). The envelope/ two-sided coating has a foam-like structure (page 4, lines 10-12; paragraph 000021; claim 9). The sealing tape is equipped with reinforcing elements for stabilizing the sealing tape in the longitudinal direction (page 4, lines 17-19; paragraph 000023; claim 10). The reinforcing element is selected from the group consisting of threads, nonwovens or interlaid scrims, wovens, knitted fabrics and crocheted fabrics (page 4, lines 19-21; paragraph 000023; claim 11).

The present invention also relates to the use of the claimed sealing tape for adhesively bonding vapour barrier films or vapour retarder films, by adhesively bonding the films to walls (page 5, lines 4-8; paragraph 000027; claim 14).



Grounds of Rejection to be Reviewed on Appeal:

1. Rejection of claims 1-4, 6-11 and 14-16 as being unpatentable under 35 U.S.C. §103(a) over WO 89/00106 (Plamthottam, et al.) in view of U.S. Publication No. 2004/0219326 (Valdez).
2. Rejection of claim 5 as being unpatentable under 35 U.S.C. §103(a) over WO 89/00106 (Plamthottam, et al.) in view of U.S. Publication No. 2004/0219326 (Valdez) and U.S. Patent No. 3,297,846 (Peltier).

Argument:

The rejection of claims 1-4, 6-11 and 14-16 as being unpatentable under 35 U.S.C. §103(a) over WO 89/00106 (Plamthottam, et al.) in view of U.S. Publication No. 2004/0219326 (Valdez) and the rejection of claim 5 as being unpatentable under 35 U.S.C. §103(a) over WO 89/00106 (Plamthottam, et al.) in view of U.S. Publication No. 2004/0219326 (Valdez) and U.S. Patent No. 3,297,846 (Peltier) are improper and should be reversed.

Rejection under 35 U.S.C. §103(a) over WO 89/00106 (Plamthottam, et al.) in view of U.S. Publication No. 2004/0219326 (Valdez)

Claims 1-4, 6-11 and 14-16

The Examiner argues in the Final Office action dated June 11, 2009 that Plamthottam, et al. discloses a self-adhesive, flexible sealing tape (Abstract) comprising at least one flexible, self-adhesive core/carrier layer (page 3, lines 11-15 of Plamthottam, et al.) provided with an envelope/two-sided coating comprising a second adhesive system (page 3, lines 17-20 of Plamthottam, et al.), wherein the envelope/coating comprises an expanded pressure-sensitive adhesive tape (page 3, lines 17-20; page 6, lines 18-22 of Plamthottam, et al.), and that the material for the core/carrier layer is selected from the group comprising thermoplastic rubbers on the basis of styrene-isoprene-styrene block copolymers, styrene-butadiene-styrene block copolymers, copolymers of vinyl acetate and acrylates (page 10, lines 4-35 of Plamthottam, et al.) that is thermally cross-linked (page 11, lines 31-35 of Plamthottam, et al.) (Final Office action, page 2, lines 5-13).

It is also the Examiner's position stated in the Final Office action that, with regard to claim 2, the material for the core/carrier layer has a glass transition temperature (T<sub>g</sub>) of

below 0°C (page 10, lines 11-15 of Plamthottam, et al.) (Final Office action, page 2, lines 13-14). The Examiner argues that, as in claim 3, the pressure-sensitive adhesive tape is based on a pure dispersion acrylate (page 30, lines 10-20, page 37, lines 25-29 of Plamthottam, et al.) (Final Office action, page 2, lines 14-16). The Examiner further states that, regarding claim 4, the pure dispersion acrylate is based on plasticizing monomers selected from the group consisting of 2-ethylhexyl acrylate, 1-butyl acrylate and n-butyl acrylate (page 30, lines 10-20, page 37, lines 25-29 of Plamthottam, et al.) (Final Office action, page 2, lines 16-18). The Examiner takes the position, with regard to claim 6, that the thickness of the core/carrier layer is between 0.1 mm and 8 mm (page 9, lines 10-12 of Plamthottam, et al.) (Final Office action, page 2, lines 18-19). Regarding claims 7 and 15, the Examiner argues that the width of the core/carrier layer is between 1 mm and 10 mm (page 9, lines 10-12 of Plamthottam, et al.) (Final Office action, page 2, line 19 – page 3, line 1). The Examiner further contends that regarding claims 8 and 16, the thickness of the envelope/coating is between 0.2 and 1.5 mm (page 9, lines 12-14 of Plamthottam, et al.) (Final Office action, page 3, lines 2-3).

The Examiner acknowledges in the Final Office action that Plamthottam, et al. fails to disclose that the envelope/two-sided coating completely surrounding at least one carrier/core layer, the envelope/coating has a foam-like structure, that the sealing tape is equipped with reinforcing elements which stabilize the sealing tape in the longitudinal direction, that the reinforcing element is selected from the group consisting of threads, nonwovens or interlaid scrims, wovens, knitted fabrics and crocheted fabrics, and that the tape is used for adhesively bonding vapour barrier films or vapour retarder films by adhesively bonding the films to walls (Final Office action, page 3, lines 3-9).

The argument of the Examiner in the Final Office action is that Valdez teaches an adhesive tape (Abstract) where the envelope/coating has a foam-like structure (page 4, paragraph 0045 of Valdez), that the sealing tape is equipped with reinforcing elements which stabilize the sealing tape in the longitudinal direction (page 4, paragraph 0049) and that the reinforcing element is selected from the group consisting of threads, nonwovens and wovens (page 4, paragraph 0049) for the purpose of forming a tape that can withstand humidity and extreme temperatures without suffering from disintegration (page 1, paragraph 0014) (Final Office action, page 3, lines 10-15).

The Examiner's conclusion, as provided in the Final Office action, is that it would have been obvious to one of ordinary skill in the art at the time the Applicant's invention was made to have provided the foam tape with the stabilizing structure in Plamthottam, et al. in order to form a tape that can withstand humidity and extreme temperatures without suffering from disintegration, as taught by Valdez (Final Office action, page 3, lines 16-19).

The Examiner also argues in the Final Office action that with regard to the limitation "the tape is used for adhesively bonding vapour barrier films or vapour retarder films, by adhesively bonding said films to walls," a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art and thus if the prior art structure is capable of performing the intended use, then it meets the claim (Final Office action, page 4, lines 1-5).

It is also part of the Examiner's argument in the Final Office action that with regard to the limitation "the envelope/two-sided coating completely surrounding at least

one carrier/core layer,” Plamthottam, et al. discloses that the layers of the adhesive tape are extruded together to form the tape and that it would have been obvious to one of ordinary skill in the art to change the shape of the layers to surround the core since it requires only a change in shape (MPEP Section 2144.04) (Final Office action, page 4, lines 6-10).

The Applicants respectfully traverse the rejection of claims 1-4, 6-11 and 14-16 being obvious in light of the cited prior art, as discussed below.

Present claim 1 recites a self-adhesive, flexible sealing tape comprising at least one flexible, self-adhesive core/carrier layer provided with an envelope/two-sided coating comprising a second adhesive system. The envelope/two-sided coating comprises an expanded pressure-sensitive adhesive tape. The envelope/two-sided coating completely surrounds/encloses said at least one core/carrier layer, and the material for the at least one core/ carrier layer is selected from the group comprising thermoplastic rubbers on the basis of styrene-isoprene-styrene block copolymers, styrene-butadiene-styrene block copolymers, copolymers of vinyl acetate, polyisobutylenes and acrylates which have been cross-linked by a process selected from the group consisting of thermally and UV irradiation.

Plamthottam, et al. teach adhesive tapes having a carrier layer comprising an electron-beam cured polymer matrix, low density microspheres and at least one pigment. While Plamthottam, et al. do not disclose a sealing tape, the reference also fails to teach that the envelope/coating comprises an expanded pressure-sensitive adhesive tape. In contrast to the Examiner’s position set forth at page 3, lines 17-20 or page 6, lines 18-22 of the Office action dated April 2, 2009, the Applicants respectfully submit that

Plamthottam, et al. fail to teach or disclose the use of expanded pressure sensitive adhesives as the envelope/two-sided coating.

Furthermore, the carrier layer of the reference always comprises low density microspheres and at least one pigment (claim 1) which is preferably fumed silica (page 4, lines 13-16 of Plamthottam, et al.). On the other hand, the presently claimed invention recites an adhesive core material which does not contain any filler. With regard to claim 2 of the present invention, it is pointed out that according to Plamthottam, et al. the PSA polymer matrices of the carrier layer comprise two different monomers in a monomer system, one monomeric part having a glass transition temperature of less than about -25°C and “[t]he balance of the monomer system may be comprised of second monomers which, if homopolymerized, would have a glass transition temperature greater than -25°C, normally greater than about 10°C” (page 10, lines 18-22). Therefore, the glass transition temperature (T<sub>g</sub>) according to Plamthottam, et al. is normally greater than 10°C, and below 0°C pursuant to present claim 2.

Moreover, the skin layer according to Plamthottam, et al., as noted by the Examiner in the Office action dated April 1, 2009, is not a pure dispersion acrylate (as recited in present claim 3), but rather is a solution acrylate.

Still further, the envelope/two-sided coating of the present invention has a thickness of between 0.2 to 1.5 mm, as set forth in present claim 8. However, the skin layers according to Plamthottam, et al. have a thickness of 1 to 5 mils (which corresponds to approximately 0.025 mm to 0.125 mm). This difference in thickness further supports the Applicants’ position that the skin layer of Plamthottam, et al. is not an expanded pressure-sensitive adhesive (PSA), while the envelope/two-sided coating of the present

invention as claimed is an expanded dispersion pressure sensitive adhesive tape based on a pure dispersion acrylate. This feature of the presently claimed invention is simply not taught or disclosed by Plamthottam, et al. alone or in combination with any teachings of the additional cited prior art.

As noted above, the Examiner had also argued that it would have been obvious to one skilled in the art in view of Plamthottam, et al. to co-extrude the carrier and the envelope so that the carrier is completely surrounded. The Applicants respectfully disagree. The Plamthottam, et al. reference explicitly teaches that the carrier layer is coated on each side with a skin layer (page 3, line 15-19), but fails to teach or disclose that the skin layer totally encloses (i.e., “surrounding/enclosing”) the carrier. Moreover, on page 6, lines 18-20 of Plamthottam, et al., the reference clearly demonstrates that the adhesive composition exits the die of the extruder onto (emphasis added) the backing film, but fails to teach or suggest that the die could cast the adhesive around (or completely surrounding/enclosing) the carrier. Plamthottam, et al. also teach that a co-extrusion process is provided for obtaining a laminate (page 6, line 23), but again fail to teach or disclose any process in which the carrier is to be enclosed (or completely surrounded) by the adhesive. The disclosure of Plamthottam, et al. clearly teaches away from the presently claimed feature of enclosing the carrier layer with an adhesive layer.

In summary, the sealing tape of the present invention as claimed differs from that of Plamthottam, et al. not only in that the envelope/coating completely surrounds/encloses the carrier/core layer, but also in that the core layer has a different composition (with a different glass transition temperature as recited in claim 2). The envelope is in contrast to Plamthottam, et al., as it is an expanded PSA, with a different

thickness of the envelope layer pursuant to Plamthottam, et al. In view of the numerous deficiencies of Plamthottam, et al., the reference, alone or in combination with any other prior art, fails to teach and/or disclose each and every limitation of the presently claimed invention.

Regarding Valdez, et al., the document was merely cited with respect to claims 10 and 11 which are drawn to embodiments having “reinforcing elements.” The reference clearly fails to make up for any of the numerous deficiencies of Plamthottam, et al. in regards to present claim 1, and the remaining claims dependent therefrom.

Valdez teaches a weatherstrip tape comprising a heat-activatable adhesive olefinic resin carrier layer in combination with a pressure-sensitive adhesive layer(s) (paragraph [0015]), wherein the support layer is releasably bonded to the second major surface of the heat-activatable adhesive layer (paragraph [0058]). Therefore, two pressure sensitive adhesive layers may be arranged on top of one another (not on both sides of the carrier layer) with a primer layer in between (paragraphs [0117], [0118]).

The possibly fibrous reinforcing elements of Valdez (paragraph [0049]) are part of a general enumeration of commonly known additives to adhesive tapes, which do not indicate a certain and special role for the intended purpose of the tape. The requirements given by Valdez on page 1 in paragraph [0014] (i.e., that the tape can withstand humidity and extreme temperature without suffering from disintegration) are general requirements of sealing tapes.

Lastly, while the tape “can reliably be used in bonding, e.g., rubber gaskets in a vehicle, in particular a motor vehicle such as a car” (paragraph [0014]), in contrast to the present invention the sealing function is totally different. One skilled in the art would not



have considered the Valdez reference at all for solving the problem which is addressed by the presently claimed invention.

In view of the above, the combination of teachings of Plamthottam, et al. and Valdez would still not have rendered the present invention obvious and would not teach every limitation of the presently claimed invention. Valdez fails to make up for any of the numerous deficiencies of Plamthottam, et al.

The Applicants' position is also that one skilled in the art would not have been motivated to modify the envelope/coating of the adhesive tapes of Plamthottam, et al. with a foam-like structure of Valdez, as argued in the Final Office action response at page 8, lines 14-22. Specifically, the Examiner's explanation pertains to the motivation for providing tapes of Plamthottam, et al. with reinforcing elements and for making the envelope/two-sided coating completely surrounding the carrier/core layer. No such motivation would exist with regard to the present limitation of claim 1 of "envelope/coating has a foam-like structure."

The Applicants also submit that present claim 1 does not require that the envelope/coating to have a foam-like structure, but rather recites that the envelope/coating comprises an expanded pressure-sensitive adhesive tape, as discussed in the Final Office action response at page 9, lines 2-10. The "foam-like structure" is recited in present claim 9. A foam-like structure is not necessarily an expanded structure, as it may be provided, for example, by incorporating rigid microspheres as taught by Plamthottam, et al. On the other hand, an expanded structure is not necessarily a foam-like structure (as argued at Final Office action response page 9, lines 2-10; present specification, paragraph [000021] "...has a foam-like structure..."; present claim 9).

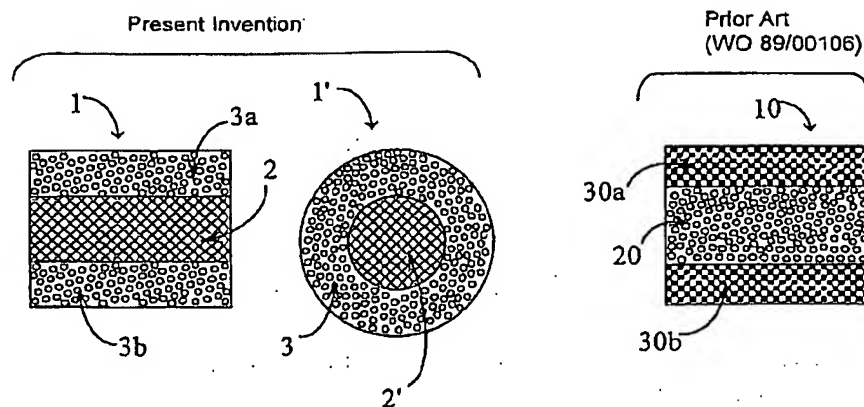
Further, in the adhesive tape of Plamthottam, et al., it is the core/carrier layer, rather than the envelope/coating, which has a foam-like structure (see, for example, claim 1 therein). Therefore, this situation of Plamthottam, et al. is not comparable to that of the presently claimed adhesive tape. It is submitted that in this regard, Plamthottam, et al. would also teach away from the presently claimed invention. Moreover, Plamthottam, et al. expressly teaches that the skin layer (envelope) is free of microspheres (page 3, lines 16-19).

Since the teachings of Plamthottam, et al. are clearly opposed to what is claimed by the present invention, the secondary reference would be required to provide a clear teaching regarding the relative position of the foamed structure (i.e., whether it is in the core/carrier or in the envelope/coating). However, Valdez fails to provide such a clear teaching. Since paragraph [0045] (page 4, quoted in the present Office action) does not refer to a tape having a core-envelope structure as presently claimed, this teaching should not be regarded as being suitable for overcoming the fact that Plamthottam, et al. teaches away from the presently claimed invention. Therefore, based on Valdez, it would not be obvious to provide the envelope/coating with a foamed structure, rather than the core/carrier layer.

Generally, the adhesive tapes disclosed by Valdez do not comprise a carrier or core layer, as is expressly stated in paragraph [0052], page 4 (“...does not include an intermediate layer.”). Due to the absence of a carrier, it is impossible to identify a layer that might correspond to the coating/skin layer of Plamthottam, et al. (or to the envelope/coating of the presently claimed adhesive tapes).

Regarding the limitation of present claim 14, the Examiner states (at page 4, first paragraph of the Final Office action) that the prior art structure would be able to perform the intended use (i.e., “adhesively bonding said films to walls”). The Applicants respectfully disagree with this conclusion since the adhesive tapes of the present invention are capable of conforming themselves to the rough surface of the substrate, e.g., a wall, is due to the presence of an expanded pressure-sensitive adhesive in the envelope layers (see, for example, present specification, paragraphs [000021], [00009]). Since the outer coatings of the tapes disclosed in Plamthottam, et al. do not comprise an expanded adhesive, these cannot be assumed to be capable of adapting themselves to a rough surface, e.g., a wall. In addition, based on the introductory section of Plamthottam, et al., it appears that this document generally does not relate to adhesive tapes that are intended for being used on rough surfaces, e.g., walls of buildings.

The Applicants also would like to emphasize that one significant difference between the presently claimed sealing tapes and those of Plamthottam, et al. concerns the foam-like (expanded) structure of the envelope of two-sided coating. In contrast to the present invention, Plamthottam, et al. teach a pressure-sensitive adhesive tape having an expanded core (carrier) layer which is coated on each side with adhesive skin layers that are not expanded (“free of microspheres;” page 3, lines 10-19). The following comparative drawings are provided to illustrate this fundamental difference between the present invention and the prior art Plamthottam, et al.



*Figure legend:*

- (1).....Sealing tape with two-sided coating (present invention);
- (1').....Sealing tape with an envelope (present invention);
- (2).....Carrier layer;
- (2').....Core layer;
- (3).....Envelope (expanded pressure sensitive adhesive);
- (3a).....First coating (expanded pressure sensitive adhesive);
- (3b).....Second coating (expanded pressure sensitive adhesive);
- (10).....Sealing tape with two-sided coating (prior art);
- (20).....Carrier layer (foam-like / comprising microspheres);
- (30a).....First coating (adhesive polymer matrix free of microspheres);
- (30b).....Second coating (adhesive polymer matrix free of microspheres).

As previously noted in the Office action response dated October 12, 2009 (page 9, lines 11-15), the Examiner has not provided any reasoning or evidence to support the position that Plamthottam, et al. would disclose an envelope/coating which comprises an expanded pressure-sensitive adhesive tape (as stated in the Final Office action, page 2, lines 5-8).

In this regard, it is respectfully submitted that the terms “expanded” and “extruded” are not synonymous. It is later stated in the Final Office action that Plamthottam, et al. teach (page 6, lines 18-22 of Plamthottam, et al.) a (co-)extrusion process. However, it is submitted that “extrusion” would be known to one skilled in the art as generally being unrelated to “expansion.” In the chemical industry, the term

“extrusion” relates to a processing operation in which a material is forced through a metal forming die, followed by cooling or chemical hardening of the extruded material (Exhibit A). In contrast, the terms “expansion” or “expand” relate to manufacturing processes in which a material (e.g., polymeric material) is caused to become larger in size or volume (Exhibit B) (similar to expanding yeast in dough).

At page 6, Section 5 (lines 5-19) of the Final Office action, the Examiner states that a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. The Applicants respectfully submit that the term “expanded” in the present claims does not relate to an “intended use.” The term “expanded” is used in the field of polymer chemistry to describe products that were obtained by employing an expansion step and which are known to be characterized by certain features (e.g., light-weight, increased volume, foamed structure). Therefore, the term “expanded” described the structure/properties of a material, rather than relating to an “intended use” as stated by the Examiner.

In view of the numerous deficiencies of Plamthottam, et al., the reference, alone or in combination with the other cited prior art, simply fails to teach and/or disclose each and every limitation of the presently claimed invention. Moreover, the reference teaches away from the presently claimed invention as discussed above. In addition, the secondary references fail to make up for any of the numerous deficiencies of Plamthottam, et al. In conclusion, it is respectfully submitted that one skilled in the art would not have considered combining the teachings of the cited prior art to arrive at the presently claimed invention, and even if such combination were performed, would not

yield each and every limitation of the present claims. Thus, the rejection of claims 1-4, 6-11 and 14-16 is in clear error and should be reversed.

Rejection under 35 U.S.C. §103(a) over WO 89/00106 (Plamthottam, et al.) in view of U.S. Publication No. 2004/0219326 (Valdez) and U.S. Patent No. 3,297,846 (Peltier)

#### Claim 5

The Examiner argues in the Final Office action that Plamthottam, et al. as modified with Valdez disclose the claimed invention except for the pressure-adhesive tape comprises an adhesive based on a material selected from the group consisting of vinyl isobutyl ether and isobutene (Final Office action, page 4, lines 15-17). The Examiner has argued that Peltier teaches a self-adhesive, flexible sealing tape (Figure 2 of Peltier) comprising at least one flexible, self-adhesive core or at least one flexible, self-adhesive carrier layer (Figure 2, #12) provided with an envelope or two-sided coating comprising a second adhesive system (Figure 2, #18 and 14), wherein the envelope/coating comprises an expanded pressure-sensitive adhesive tape (column 3, lines 61-70 of Peltier), wherein the pressure-sensitive adhesive tape comprises an adhesive based on a material selected from the group consisting of vinyl isobutyl ether and isobutene (column 3, lines 62-65 of Peltier) for the purpose of attaching the tape to a surface (column 3, lines 64-66 of Peltier) (Final Office action, page 5, lines 1-8). The Examiner has concluded that it would have been obvious to one of ordinary skill in the art at the time the Applicant's invention was made to have provided the adhesive in the modified invention of Plamthottam, et al. in order to attach the tape to a surface as taught by Peltier (Final Office action, page 5, lines 9-11).

Regarding the rejection of claim 5, the claim relates to the polymer composition of the expanded adhesive tape which constitutes the envelope/coating (original description, page 5, first and second paragraphs). Peltier discloses an adhesive layer formed from plasticized polyisobutylene. However, this is no indication whether this polymer type would be suitable for producing an expanded envelope/coating layer as recited in present claim 1. Therefore, using such polymer for producing an expanded adhesive layer would not be obvious to one skilled in the art.

Moreover, the Applicants submit that the alleged modification would not be obvious based on Plamthottam, et al. since there is no clear teaching as to whether polyisobutylene should be included in the carrier layer or coating layers (none of these layers are “expanded” as explained above). It is further noted that “vinyl isobutyl ether,” which is also recited in claim 5, is not taught by Peltier.

Regarding Peltier, the reference fails to make up for the numerous deficiencies of Plamthottam, et al., alone or in combination with Valdez. In particular, the reference teaches a fire sensing tape comprising an elongated flexible electrically non-conductive carrier of synthetic plastic sheet material with an elongated flexible electrically conductive stripe fixed to one side of the carrier (preferably centered between the side edges of the carrier and containing metal, preferably silver particles) and a pressure sensitive adhesive on the opposite side of the carrier. However, neither the carrier nor the stripe, both of which could function as a carrier, is a self-adhesive tape itself in accordance with the present invention as recited in claim 5 via claim 1. Additionally, neither is completely surrounded/enclosed by a second adhesive, which in this case is preferably a pressure sensitive adhesive composition such as a plasticized

polyisobutylene (col. 3, lines 62-64). This is not, according to the adhesive of the present invention, a dispersion acrylate which is expanded.

Moreover, Peltier fails to teach or disclose the adhesive being an expanded pressure-sensitive adhesive tape, nor does it teach or disclose how the electrically conductive stripe is fixed to the carrier layer (col. 3, last paragraph): “The stripe material ... is applied to the carrier 12 by any conventional means as for example by brush painting, spraying, a ruling pen or a striping disc.” Since Peltier is clearly not only directed to a totally different product, but fails to give any motivation as to how one skilled in the art would arrive at the present invention even if combined with the teachings of Plamthottam, et al. and Valdez, it is submitted that the presently claimed invention is clearly not rendered obvious in view of the combination of the teachings of the cited references.

Thus, the rejection of claim 5 is in clear error and should be reversed.

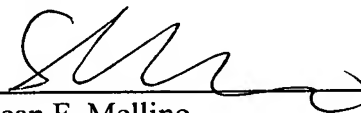


## Conclusion

The Applicant respectfully submits that the cited references do not teach, suggest or show the present invention as presently claimed or advantages attendant thereto. In conclusion it is requested that the rejection of claims 1-4, 6-11 and 14-16 as being unpatentable under 35 U.S.C. §103(a) over WO 89/00106 (Plamthottam, et al.) in view of U.S. Publication No. 2004/0219326 (Valdez) and the rejection of claim 5 as being unpatentable under 35 U.S.C. §103(a) over WO 89/00106 (Plamthottam, et al.) in view of U.S. Publication No. 2004/0219326 (Valdez) and U.S. Patent No. 3,297,846 be withdrawn, that the Board reverse the decision of the Examiner and allow claims 1-11 and 14-16.

Date: 2/17/10

Respectfully submitted,

By:   
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Att.: Exhibits A & B; 3 patent references  
Appendix of claims  
Evidence Appendix  
Related Proceedings Appendix

## Appendix of Claims

1. (previously presented) A self-adhesive, flexible sealing tape comprising at least one flexible, self-adhesive core/carrier layer provided with an envelope/ two-sided coating comprising a second adhesive system, wherein the envelope/two-sided coating comprises an expanded pressure-sensitive adhesive tape, said envelope/two-sided coating completely surrounding/enclosing said at least one core/carrier layer, and that the material for the at least one core/ carrier layer is selected from the group comprising thermoplastic rubbers on the basis of styrene-isoprene-styrene block copolymers, styrene-butadiene-styrene block copolymers, copolymers of vinyl acetate, polyisobutylenes and acrylates which have been cross-linked by a process selected from the group consisting of thermally and UV irradiation.
2. (previously presented) The sealing tape according to claim 1, wherein the material for the core/the carrier layer has a glass transition temperature (T<sub>g</sub>) of below 0 °C.
3. (previously presented) The sealing tape according to claim 1, wherein the pressure-sensitive adhesive tape is based on a pure dispersion acrylate.
4. (previously presented) The sealing tape according to claim 3, wherein the pure dispersion acrylate is based on plasticizing monomers selected from the group consisting of 2-ethylhexyl acrylate, 1-butyl acrylate and n-butyl acrylate.
5. (previously presented) The sealing tape according to claim 1, wherein the pressure-sensitive adhesive tape comprises an adhesive based on a material selected from the group consisting of vinyl isobutyl ether and isobutene.
6. (previously presented) The sealing tape according to claim 1, wherein the thickness of the core/the carrier layer is between 0.1 mm and 8 mm.

7. (previously presented) The sealing tape according to claim 1, wherein the width of the core/the carrier layer is between 1 mm and 10 mm.
8. (previously presented) The sealing tape according to claim 1, wherein the thickness of the envelope/two-sided coating is between 0.2 and 1.5 mm.
9. (previously presented) The sealing tape according to claim 1, wherein the envelope/two-sided coating has a foam-like structure.
10. (previously presented) The sealing tape according to claim 1, wherein the sealing tape is equipped with reinforcing elements which stabilise the sealing tape in the longitudinal direction.
11. (previously presented) The sealing tape according to claim 1, wherein the reinforcing element is selected from the group consisting of threads, nonwovens or interlaid scrims, wovens, knitted fabrics and crocheted fabrics.
12. (withdrawn) A process for the manufacture of a self-adhesive, flexible sealing tape comprising at least one flexible, self-adhesive core/carrier layer provided with an envelope/ two-sided coating including a second adhesive system, comprising the steps of:
- manufacturing the core/carrier layer and the envelope/ two-sided coating in independent processes as web-like materials;
- subsequently advancing two pre-fabricated pressure-sensitive adhesive tapes, one per side, towards a web consisting of the elastic core material/carrier layer material; and
- applying pressure to combined said pre-fabricated tapes with said web.
13. (withdrawn) The process according to claim 12, for the manufacture of the expanded pressure-sensitive adhesive tape further comprising the step of producing an aqueous dispersion of the pressure-sensitive adhesive and containing a filler comprising small,

thermoplastic hollow plastic spheres filled with hydrocarbon gas, said hollow spheres expanding upon exposure to a temperature in the range between 70 °C and 140 °C; processing the dispersion to a pressure-sensitive adhesive tape; and expanding said adhesive tape.

14. (previously presented) Use of a sealing tape according claim 1 for adhesively bonding vapour barrier films or vapour retarder films, by adhesively bonding said films to walls.

15. (previously presented) The sealing tape according to claim 6, wherein the thickness of the core/the carrier layer is between 1 mm and 5 mm.

16. (previously presented) The sealing tape according to claim 8, wherein the thickness of the envelope/two-sided coating is between 0.5 mm and 1 mm.

Evidence Appendix

- I. WO 89/00106 (Plamthottam, et al.)
- II. U.S. Publication No. 2004/0219326 (Valdez)
- III. U.S. Patent No. 3,297,846 (Peltier)
- IV. Exhibit A
- V. Exhibit B

Related Proceedings Appendix

None.

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Web

A

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### Definitions of **extrusion** on the Web:

- bulge: something that bulges out or is protuberant or projects from its surroundings; "the gun in his pocket made an obvious bulge"; "the hump of ...
- squeezing out by applying pressure; "an unexpected extrusion of toothpaste from the bottom of the tube"; "the expulsion of pus from the pimple"  
[wordnetweb.princeton.edu/perl/webwn](http://wordnetweb.princeton.edu/perl/webwn)
- Extrusion is a process used to create objects of a fixed cross-sectional profile. A material is pushed or drawn through a die of the desired cross ...  
[en.wikipedia.org/wiki/Extrusion](http://en.wikipedia.org/wiki/Extrusion)
- A manufacturing process where a billet of material is pushed and/or drawn through a die to create a shaped rod, rail or pipe; An item formed by ...  
[en.wiktionary.org/wiki/extrusion](http://en.wiktionary.org/wiki/extrusion)
- extrude - form or shape by forcing through an opening; "extrude steel"  
[wordnetweb.princeton.edu/perl/webwn](http://wordnetweb.princeton.edu/perl/webwn)
- the method of processing plastic by forcing heat softened plastic through an opening of the desired shape of the cross-section of the finished product.  
[www.proplasticsinc.com/glossary\\_of\\_terms.html](http://www.proplasticsinc.com/glossary_of_terms.html)
- The creation of a three-dimensional object by pushing out a two-dimensional outline and giving it height, like a cookie-cutter. It is often used to create 3D text.  
[www.blender.org/documentation/html/q13030.html](http://www.blender.org/documentation/html/q13030.html)
- The compacting of a plastic material and forcing of it through an orifice in more or less continuous fashion.  
[www.all-pak.com/plasticgloss.asp](http://www.all-pak.com/plasticgloss.asp)
- The process of producing vinyl or aluminum shapes by forcing heated material through an orifice in a die. Also, any item made by this process.  
[www.windowsonwashington.net/Pages/Service/Glossary/GlossaryC-G.aspx](http://www.windowsonwashington.net/Pages/Service/Glossary/GlossaryC-G.aspx)
- The process of forcing metal or plastic through a form in order to create a desired shape.  
[printnshipgrafx.com/resources/glossary.html](http://printnshipgrafx.com/resources/glossary.html)
- A form produced by forcing material through a die. Most window frames are clad with extruded vinyl or aluminum.  
[www.nortonsqualityexteriors.com/learning-center/glossary-roofing-windows.html](http://www.nortonsqualityexteriors.com/learning-center/glossary-roofing-windows.html)
- A process whereby resins are melted, heated and pumped. Material is sheared between a screw and the wall of the barrel into which it is set. Frictional energy heats and melts the substance as it is conveyed down the barrel. Melted extrudate is further processed post-extrusion.  
[www.petco.co.za/index.cfm](http://www.petco.co.za/index.cfm)

- Shaping plastic by forcing through a die.  
[www.mindfully.org/Plastic/Ocean/Plastic-Aquatic-EPA842B92010-Dec92\\_6.htm](http://www.mindfully.org/Plastic/Ocean/Plastic-Aquatic-EPA842B92010-Dec92_6.htm)
- The process, in which a heated material is forced through a die, used to produce aluminum, vinyl (PVC) and other profiles or components used in the production of windows and doors. ...  
[www.windowanddoor.com/article/resource/industry-glossary](http://www.windowanddoor.com/article/resource/industry-glossary)
- The emission of magmatic material at the earth's surface. Also, the structure or form produced by the process (eg, a lava flow, volcanic dome ...  
[library.thinkquest.org/05aug/01412/lite/terminology/index.html](http://library.thinkquest.org/05aug/01412/lite/terminology/index.html)

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## Web

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Definitions of **expand** on the Web:**EXHIBIT**

B

- extend in one or more directions; "The dough expands"
- become larger in size or volume or quantity; "his business expanded rapidly"
- make bigger or wider in size, volume, or quantity; "expand the house by adding another wing"
- boom: grow vigorously; "The deer population in this town is thriving"; "business is booming"
- inflate: exaggerate or make bigger; "The charges were inflated"
- elaborate: add details, as to an account or idea; clarify the meaning of and discourse in a learned way, usually in writing; "She elaborated on the main ideas in her dissertation"
- extend: expand the influence of; "The King extended his rule to the Eastern part of the continent"  
[wordnetweb.princeton.edu/perl/webwn](http://wordnetweb.princeton.edu/perl/webwn)
- expand is a command in the UNIX Operating System. It is used to convert groups of tabs into space characters.  
[en.wikipedia.org/wiki/Expand\\_\(Unix\)](http://en.wikipedia.org/wiki/Expand_(Unix))
- To change (something) from a smaller form and/or size to a larger one; To increase the extent, number, volume or scope of (something); To express (something) at length and/or in detail; (algebra) To rewrite (an expression) as a longer, yet equivalent sum of terms; To (be) change(d) from a ...  
[en.wiktionary.org/wiki/expand](http://en.wiktionary.org/wiki/expand)
- expansion - a function expressed as a sum or product of terms; "the expansion of  $(a+b)^2$  is  $a^2 + 2ab + b^2$ "  
[wordnetweb.princeton.edu/perl/webwn](http://wordnetweb.princeton.edu/perl/webwn)
- expanded - increased in extent or size or bulk or scope  
[wordnetweb.princeton.edu/perl/webwn](http://wordnetweb.princeton.edu/perl/webwn)
- expansion - a discussion that provides additional information
- expansion - adding information or detail  
[wordnetweb.princeton.edu/perl/webwn](http://wordnetweb.princeton.edu/perl/webwn)
- Expansion - In universal algebra and in model theory, a reduct of an algebraic structure is obtained by omitting some of the operations and relations of that structure. The converse of "reduct" is "expansion."  
[en.wikipedia.org/wiki/Expansion\\_\(model\\_theory\)](http://en.wikipedia.org/wiki/Expansion_(model_theory))
- Expansion is a live album released by jazz pianist Dave Burrell. It was recorded during a number of concerts in December 2003 and was released on ...  
[en.wikipedia.org/wiki/Expansion\\_\(album\)](http://en.wikipedia.org/wiki/Expansion_(album))

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**Valdez**

(10) **Pub. No.: US 2004/0219356 A1**

(43) **Pub. Date: Nov. 4, 2004**

(54) **WEATHERSTRIP TAPE AND METHOD FOR  
PRODUCING THE SAME**

(52) **U.S. Cl. .... 428/345; 428/349; 156/244.17;  
156/272.6**

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(57) **ABSTRACT**

(21) **Appl. No.: 10/477,567**

(22) **PCT Filed: May 20, 2002**

(86) **PCT No.: PCT/US02/16134**

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**May 30, 2001 (EP)..... 01112836.0**

**Publication Classification**

(51) **Int. Cl.<sup>7</sup> ..... B32B 7/12; B32B 31/00**

The present invention relates to an adhesive tape and to a method for its manufacture, the tape comprising: (A) a heat-activatable adhesive resin layer, wherein the resin is a polymer of one or more monomers selected from the group consisting of olefins, and (B) a pressure-sensitive adhesive layer, comprising an acrylic-type pressure sensitive adhesive, wherein said pressure sensitive adhesive layer is permanently and directly bonded to a first major surface of said heat-activatable adhesive layer. The present invention also relates to an intermediate article comprising the heat-activatable adhesive resin layer (A) releasably bonded to a support layer, to a composite article comprising the adhesive tape and a rubber article bonded to the second major surface of the heat-activatable layer (A), and to a vehicle comprising the composite article.

A pressure sensitive adhesive tape comprises a carrier layer having a thickness of 0.25 to 2.0 millimeters and comprising an electron beam cured pressure sensitive adhesive matrix, 10 to 20 % by volume low density microspheres and at least one pigment in an amount sufficient to color the tape. Preferably, fumed silica is present in an amount up to 5 % by weight. The tape preferably has a skin layer on each side of the carrier layer. The skin layer has a coating thickness of 25 to 125 g/m<sup>2</sup> and comprises a pressure sensitive adhesive matrix free of rigid, low density microspheres. The process comprises first preparing an adhesive composition containing electron beam-curable adhesive polymer matrix, fillers and solvent. The composition is introduced and conveyed through a twin screw extruder (10). In the extruder, solvent is removed in one or more solvent removal units (11, 12, 13), and a solvent-free composition is extruded as the carrier layer. Skin layers may be coextruded with the carrier layer.

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10        HIGH PERFORMANCE PRESSURE SENSITIVE ADHESIVE TAPES  
              AND PROCESS FOR MAKING THE SAME

Field of the Invention

15            This invention relates to pressure sensitive  
              adhesive tapes and more particularly to electron beam-  
              cured double-coated acrylic and rubber based pressure  
              sensitive adhesive foam-like tapes and a process for  
              making such tapes.

20        Background of the Invention

              A variety of double-coated foam tapes are being  
              used for structural bonding in certain applications  
              replacing spot welds, tack welds; or rivets. Such  
              applications include, for example, the bonding of side  
25        molding to automobiles, fiberglass body panels to motor  
              homes, plexiglass inspection windows onto equipment  
              cabinets, and the like. The foam layer of these tapes  
              usually has a polymer matrix based on polyethylene,  
              polyurethane, polyvinyl chloride, or polychloroprene.  
30        These tapes exhibit poor conformability around curved  
              substrates.

              U.S. Patent No. 4,223,067 to Levens, assigned to  
              Minnesota Mining and Manufacturing Co., describes a  
              method for making conformable foam-like acrylic pressure  
35        sensitive adhesive tapes using on web-polymerization

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1 technology. In the process, a mixture of monomers and  
20 to 65 volume percent glass microbubbles is coated  
onto a backing sheet and then polymerized to a pressure  
sensitive adhesive state. The polymerization may be  
5 initiated by ultraviolet light or less preferably by  
heat if the mixture includes a heat-activatable  
polymerization initiator.

The tapes disclosed by Levens are fairly elastic  
under briefly applied stresses but exhibit low  
10 elasticity under prolonged stress and therefore adhere  
to rough and uneven surfaces. These tapes exhibit high  
peel adhesion. The method of Levens, however, requires  
a long duration to complete polymerization. This makes  
the tapes expensive to produce. Moreover, coatings  
15 having a thickness greater than about 0.2 mm involving  
neat monomers tend to produce excessive bubbles. If  
ultraviolet light is used to accomplish polymerization,  
the composition must be UV transparent. This means that  
the composition must be free of coloring pigments, or  
20 other ultraviolet light absorbing fillers. Also,  
because the process requires the compositions to  
comprise a photoinitiator, the compositions tend to  
yellow over time.

U.S. Patent No. 4,612,242 to Vesley et al., also  
25 assigned to Minnesota Mining and Manufacturing Co.,  
indicated that the white color of the Levens tape,  
caused by the absence of pigment, made the tape  
undesirably visible in certain applications, but that  
the addition of carbon black in an amount sufficient to  
30 produce a desirable black appearance would block the  
ultraviolet radiation from polymerizing the mixture to a  
pressure-sensitive adhesive state. Vesley et al.'s  
solution to the problem was to coat the glass  
microbubbles with an inorganic film, e.g. silver, having  
35 a thickness that does not unduly inhibit polymerization.

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1           While the method of Vesley et al. does impart some  
color to the tapes, it has certain drawbacks. It still  
takes a long time to effect polymerization, making the  
tapes expensive to produce. Moreover, glass  
5           microbubbles having an inorganic coating are expensive,  
adding to the cost of producing the tapes. Only a  
limited number of colors are available in this process.

#### Summary of the Invention

10           The present invention provides a pressure sensitive  
adhesive (PSA) tape comprising at least one carrier  
layer having a composition comprising a cross-linked  
polymer matrix, preferably a cross-linked PSA polymer  
matrix, and more preferably, an electron beam-cured PSA  
15           polymer matrix. The carrier layer further comprises low  
density microspheres and at least one pigment. The  
carrier layer is preferably coated on each side with a  
skin layer having an adhesive polymer matrix free of  
rigid low density microspheres.

20           The polymer matrix of the carrier layer is  
preferably an acrylic based PSA polymer matrix or a  
rubber based PSA polymer matrix. The polymer matrix  
constitutes from 30% to about 90% by volume, preferably  
from about 55% to about 90% by volume and more  
25           preferably from about 70% to about 85% by volume of the  
carrier layer, the balance being made up of fillers.

          The low density microspheres of the carrier layer  
are generally in the size range of from about 10 microns  
to about 300 microns and may be made of ceramic,  
30           polymeric, glass, carbon or other suitable material.  
Mixtures of such low density microspheres may be used.  
The low density microspheres may be solid, hollow or  
porous, rigid or elastomeric, and tacky or nontacky.  
The material of the low density microspheres, if  
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-4-

1 desired, may be selected to cross-link with the polymer matrix during curing.

5 The low density microspheres are present in an amount of from about 5% to about 70% by volume of the carrier layer and preferably in an amount of from about 5% to about 45% by volume and more preferably in an amount of from about 10% to about 20% by volume of the carrier layer.

10 The pigment is present in an amount sufficient to impart the desired color to the tape. Pigment may be a solid inorganic filler such as carbon black, titanium dioxide or the like, or may be an organic dye.

15 Preferably, the carrier layer comprises fumed silica in an amount of up to about 5% by weight and more preferably in an amount of from about 1% to about 2% by weight.

20 The thickness of the carrier layer is not critical but is preferably in the range of from about 0.25 mm to about 4.0 mm and more preferably in the range of from about 0.25 mm to about 2.0 mm. The coating thickness of the rigid low density microsphere-free skin layers is preferably about 25 to about 125 grams/square meter.

25 The foam-like tapes of the present invention exhibit high conformability which arises from the low elastic memory of the carrier layer. The tapes also exhibit high failure strain, high cleavage peels and tensile adhesion, and good gasoline and moisture resistance. If inherently tacky PSA low density microspheres are used, the tapes also exhibit greatly improved cold temperature properties.

30 The invention further provides a process for rapidly producing curable bubble-free PSA tapes as described above in virtually any practical thickness. The adhesive sheet materials are produced from an adhesive composition containing from about 40% to about 35



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1     80% solids, i.e., about 20% to about 60% by volume  
solvent.     The "solids" portion of the adhesive  
composition comprises a curable adhesive polymer matrix  
and may comprise one or more fillers such as pigments,  
5     solid, hollow or porous low density microspheres and the  
like. The curable adhesive polymer matrix comprises one  
or more monomers which have been at least partially  
polymerized and preferably completely polymerized.

10     In the process, the adhesive composition is  
introduced into a twin screw extruder through an  
upstream feeding unit at the entrance of the extruder  
barrel. The rotating screws of the extruder convey the  
adhesive composition downstream through the extruder  
barrel from the feeding unit to a die at the downstream  
15     end of the extruder. At the downstream end, the  
adhesive composition exits the extruder through the die.

At one or more locations downstream of the feeding  
unit, the extruder comprises a solvent removal unit.  
The solvent removal unit comprises a barrel section  
20     having a vent opening. A conduit or duct encloses the  
vent opening and extends from the vent opening to a  
vacuum pump. The vacuum pump is arranged to reduce the  
atmospheric pressure within the duct, the vent opening  
and the barrel section to thereby draw off solvent  
25     present in the adhesive composition moving through that  
barrel section.

In the process, the temperature of the material  
passing through the barrel section of the solvent  
removal unit and the atmospheric pressure within the  
30     barrel section are adjusted to cause the solvent in the  
material to evaporate and be drawn off without drawing  
any of the adhesive composition through the vent  
opening. Elevated temperatures of from about 100°C to  
about 160°C in combination with an atmospheric pressure  
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-6-

1 of from about 50 to about 100 torr are presently preferred.

5 In a preferred embodiment of the invention, the extruder is provided with two or more solvent removal units. Each solvent removal unit comprises a barrel section having a vent opening which is connected by a duct to a vacuum pump to reduce the atmospheric pressure within the barrel section. In an embodiment involving three solvent removal units, it is presently preferred  
10 that approximately 80% of the solvent in the composition is removed as the adhesive composition passes through the barrel section of the first solvent removal unit; an additional 18% to 19% of the solvent is removed as the adhesive composition passes through the barrel section  
15 of the second solvent removal unit; and another 1% to 2% is removed as the adhesive composition passes through the barrel section of the third solvent removal section.

After the solvent is removed, the adhesive composition preferably exits the die of the extruder  
20 onto a backing film or the like.

In a particularly preferred embodiment of the invention, there is provided a co-extrusion process for making a laminated PSA composition having at least one first layer, e.g. a carrier layer, of a particular first  
25 polymeric composition which may or may not be a PSA composition and at least one second layer, e.g. a skin layer, of second composition which is a PSA composition. The process utilizes two twin screw extruders, each having one or more solvent removal units as described  
30 above. A first mixture comprising the first composition and solvent is introduced into the first extruder. Simultaneously, a second mixture comprising the second composition and solvent is introduced into the second extruder. In each extruder, the solvent is stripped by  
35 the solvent removal unit, and the composition is passed

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1 into a single sheet die from which the laminated PSA  
sheet material is extruded.

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1     Brief Description of the Drawings

These and other features and advantages of the present invention will be better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a longitudinal, cross-sectional view of an extruder useful in the practice of the present invention;

FIG. 2 is a transverse cross-sectional view of the extruder taken through lines 2-2;

FIG. 3 is a transverse cross-sectional view of the barrel showing an alternatively preferred feed unit;

FIG. 4 is a schematic view of the extruder barrel showing the screw profile; and

FIG. 5 is a fragmentary cross-sectional view showing an adaptor for extending a laminated PSA sheet.

FIG. 6 is a fragmentary cross-sectional view of a preferred die assembly.

FIG. 7 is a top cutaway view of the die assembly of FIG. 6 taken along lines 7-7.

FIG. 8 is a front view of the die assembly of FIG. 6.

FIG. 9 is a schematic view of an extruder barrel showing a particular screw profile; and

FIG. 10 is a schematic view of an extruder barrel showing another particular screw profile.

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1     Detailed Description of the Invention

      In a particularly preferred embodiment of the present invention, there is provided a foam-like double-coated PSA tape having excellent conformability, high  
5     failure strain, high cleavage peels and tensile adhesion, and good solvent resistance. The double-coated PSA tape is a composite structure comprising a middle carrier layer and a skin layer on each side of the carrier layer.

10       The thickness of the carrier layer is not critical but is preferably from about 0.25 mm to about 4.0 mm and more preferably from about 0.25 mm to about 2.0 mm. Likewise the coating thickness of the skin layer is not critical but is preferably in the range of from about 25  
15     g/m<sup>2</sup> (approximately 1 mil) to about 125 g/m<sup>2</sup> (approximately 5 mils).

      Carrier layers having a thickness greater than about 4.0 mm are not preferred because they contain excess material which is generally not needed for most  
20     applications. Further, thicker carrier layers tend to be more visible in a particular application and are therefore not generally preferred because they are less aesthetically pleasing. Such carrier layers also require higher voltages for electron-beam curing.  
25     Carrier layers having a thickness less than about 0.25 mm are not preferred because they tend to exhibit insufficient conformability and thus are less suitable for use with irregular surfaces. Thicknesses in the range of about 0.25 mm to about 2.0 mm are suitable for  
30     most applications.

      The skin layers typically exhibit better adhesion than the carrier layer and thus enhance the overall adhesion of the tape. Skin layers having a coating thickness less than about 25 g/m<sup>2</sup> are not preferred  
35     because no significant benefit is seen. Skin layers

-10-

1       having a coating thickness greater than about 125 g/m<sup>2</sup>  
are not preferred because no additional benefit is seen  
with greater thickness.

5       In accordance with the invention, the carrier layer  
comprises a cross-linked polymer matrix, low density  
microspheres, and at least one colored pigment. The  
polymer matrix is preferably an acrylic based PSA  
polymer matrix or a rubber based PSA polymer matrix.  
10       Cross-linking is preferably accomplished by electron-  
beam curing.

Acrylic-based PSA polymer matrices generally  
comprises one or more first monomers, which if  
homopolymerized, would have a glass transition  
temperature of less than about -25°C based on the total  
15       weight of the monomers. Examples of such monomers  
include alkyl acrylates such as butylacrylate,  
propylacrylate, 2-ethyl hexylacrylate, isooctyl  
acrylate, isodecylacrylate, and the like. The balance  
of the monomer system may be comprised of second  
20       monomers which, if homopolymerized, would have a glass  
transition temperature greater than -25°C, normally  
greater than about 10°C. Among such monomers there may  
be mentioned ethyl acrylate, alkyl methacrylate such  
as methyl methacrylate, ethyl methacrylate, butyl  
25       methacrylate and the like; co-polymerizable vinyl-  
unsaturated monomers such as vinyl acetate, vinyl  
propionate and the like; and styrenic monomers such as  
styrene, methyl styrene and the like, unsaturated  
carboxylic acids such as acrylic acid, methacrylic acid,  
30       itaconic acid, fumaric acid, and the like; acrylamide,  
vinyl caprolactam and the like. Suitable polymers are  
described, for example in co-pending U.S. Patent  
Application Serial Number 916,717, which is incorporated  
herein by reference.

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1 Rubber-based PSA polymer matrices useful in the  
practice of the present invention may be formulated as  
solvent, hot melt, or emulsion, with holt melt or  
solvent based adhesives presently being preferred. The  
5 PSA matrices employed are normally based on di-block and  
tri-block polymers and mixtures thereof. Other resin-  
modified elastomers could be used. The matrix polymer,  
to be functional, should have a net effective glass  
transition temperature of from about 15°C to about 70°C  
10 below the use temperature, preferably from about 35°C to  
about 70°C below the use temperature. Rubber based  
adhesive suitable for use in the present invention are  
described in U.S. Patent Nos. 3,239,478 to Harlan,  
4,152,231 to St. Clair, et al., 3,676,202 to Korpman,  
15 3,783,072 to Korpman, 3,932,328 to Korpman and 4,028,292  
to Korpman and partially in U.S. Patent application  
Serial No. 896,127, all of which are incorporated herein  
by reference.

It is preferred that the polymer matrix of the  
20 carrier layer be a PSA polymer matrix. It is  
understood, however, that other materials may be used as  
the polymer matrix. Non-PSA polymers suitable for use  
as the polymer matrix of the carrier layer include  
polyethylene, ethylene propylene rubbers, neoprene,  
25 butyl rubber and the like.

Cross-linking of the polymer matrix is preferably  
accomplished by electron-beam curing. Accordingly, it  
is understood that other electron beam curable polymer  
materials such as electron beam curable silicones, may  
30 also be used, if desired.

While not presently preferred, other suitable  
methods for curing the polymer matrix may be used. For  
example, if the polymer matrix comprises a heat-  
activatable cross-linking agent, curing by the  
35 application of heat may be used. If the polymer matrix

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1 also contains a microwave absorbing agent, microwave  
radiation may be used to effect curing. Because of the  
presence of pigment in the polymer matrix, ultra-violet  
radiation is not an appropriate method for curing the  
5 polymer matrix of the present invention.

The polymer matrix is present in the carrier layer  
in an amount of from about 30% and preferably from about  
55% to about 90% by volume, and more preferably in an  
amount of from about 70% to about 85% by volume. Stated  
10 in another way, the total amount of fillers should be at  
least 10% by volume and no more than about 70%, and  
preferably no more than about 45% by volume, and more  
preferably in the range of from about 15% to about 30%  
by volume. Carrier layers having more than about 45  
15 volume percent fillers, or more than about 70 volume  
percent fillers, if very low density fillers, e.g.,  
penolic hollow microspheres, are used, tend to exhibit  
low elongation and high modulus and not generally  
suitable for PSA applications. Likewise, carrier  
20 layers having less than about 10% by volume fillers are  
not preferred because the resultant tapes generally  
possess too low of a modulus.

Carrier layers having from about 15 to about 30  
volume percent fillers are most preferred because such  
25 compositions tend to exhibit the best combination of  
properties such as elongation and tensile strength.

The carrier layer also comprises from about 5% to  
about 70% by volume, preferably 5% to about 45% by  
volume, and more preferably from about 10% to about 20%  
30 by volume low density microspheres. The low density  
microspheres tend to reduce the density of the carrier  
layers, generally improve peel adhesion and thereby  
improve conformability and also improves the strength  
properties, i.e. the combination of elongation and  
35 tensile strength of the layer.



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1           The low density microspheres may be solid, hollow  
or porous and rigid or elastomeric. The low density  
microspheres may be made of any suitable material  
including glass, ceramic, polymeric and carbon  
5 materials.

Polymeric low density microspheres may be made of  
rigid materials or elastomeric materials. Suitable  
rigid polymeric materials include thermosetting  
polymers, e.g., phenolic polymers, or thermoplastic  
10 polymers, e.g., polyvinylidene chloride acrylonitrile  
copolymers (PVDC copolymers). It is expected that  
thermoplastic polymer microspheres will cross-link and  
graft to the polymer matrix when electron-beam  
radiation is used to cure the polymer matrix. By cross-  
15 linking the low density microspheres and grafting to the  
polymer matrix, properties such as tensile strength  
could be improved.

Preferred elastomeric low density microspheres are  
made of a PSA material and exhibit a very low glass  
20 transition temperature ( $T_g$ ), are infusible, insoluble  
and inherently tacky. Such elastomeric low density  
microspheres can be made, for example, by suspension  
polymerization as disclosed in U.S. Patent Nos.  
3,691,140 to Silver, 3,857,731 and 4,166,152 to Baker et  
25 al., and 4,495,318 to Howard, and U.S. Patent  
Application Serial No. 138,509, all of which are  
incorporated herein by reference.

Infusible low density microspheres disclosed in  
U.S. Patent Nos. 4,735,837, 4,049,483, 4,645,783,  
30 4,624,893, 4,636,432, 4,598,112, Japanese Patent No.  
61258854, all of which are incorporated herein by  
reference, are also suitable for use in the present  
invention.

It has been found that the incorporation of  
35 elastomeric low density microspheres in the carrier

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1 layer improves the low temperature performance of the  
foam tapes of the present invention, particularly in  
cold slam tests, e.g., Fisher Body Materials Testing  
(FBMT) 45-89, at temperatures of, for example, -20°C and  
5 -30°C.

As used herein, "low density microspheres" include  
rigid microspheres having a density of less than about  
1.0 g/cc and elastomeric microspheres having a density  
of less than about 1.5g/cc. Accordingly, rigid  
10 microspheres made of glass, ceramic or other material  
and having a density greater than about 1.0 g/cc and  
elastomeric microspheres having a density greater than  
about 1.5g/cc are not preferred. Such high density  
microspheres tend to adversely increase the density of  
15 the carrier layer requiring higher electron-beam  
voltages for curing.

Hollow microspheres, which are generally available  
in a wide variety of densities and crush strengths, are  
presently preferred. Ceramic hollow microspheres are  
20 particularly preferred because they exhibit high crush  
strength and tend to be less expensive than glass,  
polymeric or carbon hollow microspheres.

The size, i.e., the average diameter, of the low  
density microspheres is preferably from about 10 to  
25 about 300 microns. Low density hollow microspheres  
having a diameter less than about 10 microns may be  
suitable but are not presently commercially unavailable  
for evaluation.

Low density hollow microspheres having an average  
30 diameter greater than about 300 microns are not  
preferred at the present time due to a lack of  
commercial availability and because they are expected to  
exhibit a undesirable low crush strength.

If the carrier layer comprises rigid, low density  
35 microspheres made of, for example, glass or ceramic

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1       having a density of from about 0.2 to about 1.0 g/cc, it  
is preferred that the loading of low density  
microspheres not exceed about 45% because carrier layers  
with higher loadings tend to exhibit very low  
5       elongation. If low density rigid microspheres having a  
density less than about 0.2g/cc, e.g., hollow phenolic  
microspheres, are used, the loading may be as high as  
about 70% by volume. If low density elastomeric  
microspheres are used, loadings as high as about 70% by  
10       volume may be used.

Carrier layers having less than about 5 volume  
percent low density microspheres of any kind are not  
preferred because the benefit of the low density  
microspheres is insufficiently realized, e.g., the peel  
15       and shear adhesion tends to be too low. Moreover, the  
density of the carrier layer increases as the volume  
loading of the low density microspheres decreases, and  
thus, low loadings requires a higher electron beam  
voltage for curing. Consequently, such carrier layers  
20       tend to be more expensive to produce. Volume loadings  
between about 10% to about 20% are most preferred  
because carrier layers having such loadings tend to  
exhibit the optimum combination of elongation and  
tensile strength and other physical properties.  
25       Particularly preferred carrier layers have from about  
15.0% to 20.0% by volume low density microspheres.

At least one pigment is present in the composition  
to give color to the tape. Solid particulate pigments  
tend to improve strength characteristics, i.e. increase  
30       the tensile strength and reduce the elongation of the  
tape. As used herein, the term "pigment" refers to any  
coloring agent compatible with or dispersible in the  
polymer matrix. The pigments may be solid particles  
such as carbon black and other particulate pigments or  
35       titanium dioxide or organic dyes such as phthalocyanine

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1 green sold by American Hoechst or 2915 dianisidine  
orange sold by Harshaw Chemical. The particular type of  
pigment used will depend upon the color desired. For  
example, carbon black may be used if the desired color  
5 is black. Titanium dioxide may be used if the desired  
color is white.

The particle size range and the loading of the  
pigment depends on the type of pigment utilized. For  
carbon black, a loading of up to about 5% by weight may  
10 be used. Loadings above 5% by weight are not preferred  
because carbon black tends to decrease the elongation at  
break. Loadings as low as about 0.25% by weight are  
found to be sufficient to impart a suitable black color  
to the tape. With respect to carbon black, any suitable  
15 commercially available carbon black may be utilized. A  
particularly preferred carbon black is Monarch 700  
carbon black, manufactured by Cabot Corporation.

In addition to the low density microspheres and  
pigment, it is preferred that the carrier layer comprise  
20 a filler such as fumed silica. Fumed silica lowers the  
elongation and increases the tensile strength of the  
carrier layer. Accordingly, the preferred amount of  
fumed silica is selected to provide the best balance of  
high elongation and high tensile strength. The fumed  
25 silica could be replaced by carbon black, if desired.

The fumed silica is preferably present in an amount  
of up to about 10% by weight of the carrier layer.  
Loadings greater than about 10% tend to result in a  
carrier layer which is too stiff and insufficiently  
30 conformable for most applications. Volume loadings of  
from about 3% to about 5% by weight have been found to  
impart the best combination of tensile strength and  
elongation and are hence presently preferred.

Small, rigid high density solid microspheres having  
35 a density greater than 1.0 g/cc and a size or average

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1 diameter of less than about 10 microns and preferably  
from about 0.1 to about 5 microns may be used as an  
alternative to or in combination with fumed silica to  
5 of the carrier layer. The small, rigid, high density  
solid microspheres may be present in an amount of up to  
about 5% by weight. Above about 5% by weight, the  
carrier layer tends to become too stiff. It is  
presently preferred that the small, rigid, high density  
10 solid microspheres be present in an amount of from about  
1% to about 2% by weight.

It is understood that the preferred loadings of the  
various above-mentioned fillers are dependent upon the  
precise characteristics which are sought and on the  
15 amounts of the other fillers present in the carrier  
layer. For example, a relatively high loading of solid  
fillers, e.g., fumed silica or small, rigid, high  
density microspheres may be preferred if the loading of  
low density microspheres is low. Lower loadings may be  
20 preferred if the amount of microspheres is high.

It is further understood that many other fillers,  
e.g., calcium carbonate, china clay, etc., may be  
incorporated into the carrier layers as desired.

The skin layers are preferably unfilled layers of  
25 an adhesive polymer matrix or, less preferably, may be  
an adhesive polymer matrix filled with pigment. The  
skin layer contains no low density microspheres. The  
polymer matrix of the skin layer may be any polymer  
matrix which exhibits good adhesion with the carrier  
30 layer. Preferred adhesive polymer matrices include PSA  
polymer matrices and heat activatable adhesive polymer  
matrices.

The carrier layers of the present invention may be  
prepared by any suitable method. For example, a mixture  
35 of the polymer matrix, fillers and solvent may be coated

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1        onto a backing film to a desired thickness. The solvent  
is then removed by drying before curing. Alternatively,  
a mixture comprising the polymer matrix and fillers and  
without solvent may be extruded as such a sheet or the  
5        like. A calendaring process may also be used.

In a particularly preferred process, the carrier  
layer is made by first preparing an adhesive composition  
containing the polymer matrix, solvent for the polymer  
matrix and the desired fillers. The composition is  
10        introduced into an extruder and conveyed through the  
extruder by the rotating screws. While in the extruder,  
the solvent is removed by vacuum evaporation in one or  
more solvent removal units. An essentially solvent-free  
composition is then extruded from the extruder. As used  
15        herein, "solvent-free" means a composition having less  
than about 2% by volume solvent.

Exemplary solvents include ethyl acetate,  
isopropanol, ethanol, hexane, heptane and toluene. The  
purpose of the solvent is to reduce the viscosity of the  
composition so that it may be easily handled in bulk,  
20        e.g., readily poured from one container to another. An  
amount of solvent sufficient to reduce the viscosity to  
less than about 100 pascal-seconds is presently  
preferred. For most compositions, an amount of solvent  
25        that provides a solids content of from about 40% to  
about 80% is sufficient for this purpose. That is,  
compositions having more than about 80% solids are not  
preferred because the viscosity remains undesirably  
high. Compositions having less than about 40% solids  
30        are not preferred because they contain excess solvent,  
i.e. more than enough solvent to reduce the viscosity to  
an easily workable level, and the excess solvent must be  
removed in the process. The particular viscosity  
desired will depend on the method by which the  
35        composition is introduced into the extruder.

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1           The particular amount of solvent required to  
achieve a desired viscosity will depend on the temper-  
ature of the composition. Accordingly, the composition  
is preferably heated to minimize the amount of solvent  
5           required to achieve the desired viscosity which, in  
turn, minimizes the amount of solvent that has to be  
removed in the process. Temperatures slightly below the  
boiling point of the composition are preferred.

          With reference to FIG. 1, there is shown  
10           schematically an apparatus suitable for use in  
practicing the present invention. The apparatus  
comprises a twin screw extruder 10 with three solvent  
removal units 11, 12, and 13 for removing solvent from  
an adhesive composition traveling through the extruder  
15           10. A sheet die 14 is mounted at the downstream end of  
the extruder 10. In such an arrangement, a solvent-  
free adhesive composition may be extruded in the form of  
a sheet.

          In the embodiment shown, a backing film or web  
20           feeding unit 16 is provided for applying a release film  
to one side of the extruded sheet. A conveying unit 17  
is also shown for carrying the extruded sheet material  
away from the extruder 10. It is understood that the  
processing of the extruded sheet, e.g., application of a  
25           backing film conveying away from the extruder,  
subsequent curing, etc., may be accomplished by any  
suitable conventional method. Subsequent curing by  
electron beam radiation is currently preferred.

          The twin screw extruder 10 may be any suitable  
30           commercially available twin screw extruder which is  
modified to include one or more solvent removal units.  
For example, extruders manufactured by Berstorff  
Corporation of West Germany, have been found to be  
suitable for use in the practice of this invention.

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1           With reference to FIG. 2, the extruder 10 comprises  
a housing or barrel 18 having a pair of side-by-side  
generally parallel and cylindrical overlapping bores 19  
forming a barrel chamber 22, in which a pair of co-  
5       rotating intermeshing screws 21 are mounted. While it  
is presently preferred that the extruder 10 have co-  
rotating screws 21, it is understood that extruders  
having counter-rotating screws may also be used. It is  
also understood that arrangements in which the screws do  
10      not intermesh can also be used. For compositions  
involving breakable low density microspheres, e.g,  
hollow glass microspheres, use of tangential screws may  
reduce breakage of the microspheres.

          The barrel 18, preferably comprises multiple sec-  
15      tions. The combination and arrangement of barrel  
sections are selected to accomplish specific tasks. The  
barrel sections may completely enclose the screws or  
have openings for feeding, venting and the like. Each  
section of the barrel is provided with a heating means  
20      so that the material within that barrel section may be  
heated to a desired temperature.

          Likewise, the screws 21 preferably comprise  
multiple elements designed to accomplish the particular  
tasks such as mixing, conveying, building pressure and  
25      the like. The combination and arrangement of screw  
elements are selected to accomplish desired tasks in a  
particular order.

          In the embodiment shown, the barrel 18 comprises  
seven sections. The first section 24 is part of a  
30      feeding unit 26 for introducing material into the  
extruder. The feeding unit 26 comprises a large feed  
hopper 27 which empties directly into the chamber 22 of  
the first barrel section 24 through an entrance port 28,  
as shown in FIG. 3. While not shown in the drawing, a  
35      feeding or metering unit may be provided at the entrance



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1 port 28 to control the rate of flow of material from the  
hopper 27 into the barrel 18.

It is understood that, rather than mixing the  
fillers, polymer matrix and solvent together and then  
5 introducing the mixture into the extruder, one or more  
of the fillers can be introduced separately. If added  
separately, it is preferred that the filler be added to  
composition already in the barrel. This provides mixing  
between the polymer matrix and the filler and reduces  
10 clumping and possible crushing of the filler by unwetted  
screws. As an example, the composition comprising  
polymer matrix and solvent may be introduced in a first  
feed unit at the first barrel section and the solid  
fillers may be introduced in a second downstream feed  
15 unit.

Alternatively, the filler and the composition  
comprising polymer matrix and solvent may be added in  
the same barrel section in an arrangement as shown in  
FIG. 3. In such an arrangement, the composition  
20 comprising polymer matrix and solvent is introduced into  
the barrel chamber 22 through an entrance port 29 at the  
bottom of the barrel 18. The composition thus  
introduced tends to puddle at the saddle area 30 of the  
barrel 18 wetting the screws 21 as they rotate. The  
25 filler is introduced into the extruder at the top of the  
barrel 18, for example through the feed hopper 27,  
directly onto the wetted screws.

If the separately added solid filler comprises  
breakable low density microspheres, e.g., hollow glass  
30 microspheres, it is presently preferred to add the  
filler at the downstream end of the extruder, i.e., at a  
location downstream from the solvent removal units, to  
reduce breakage of the low density microspheres. In  
such an embodiment, the screws, if desired, may be  
35 intermeshing through the solvent removal units to

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1       enhance devolatization of the adhesive composition and  
then become tangential at the downstream and of the  
extruder where the breakable low density microspheres  
are added.

5           The first, second, and third solvent removal units  
11, 12, and 13 are located downstream of the feeding  
unit at the fourth, fifth and sixth barrel sections 31,  
32, and 33 respectively. As shown in FIG. 2, each of  
the fourth, fifth and sixth barrel sections 31, 32 and  
10       33 has a large vent opening 34 at the top of that barrel  
section. A duct 36 extends from the vent opening 34 to  
a vacuum pump 37 for reducing the atmospheric pressure  
within the duct 36, vent opening 34 and that barrel  
section. In the embodiment shown, each solvent removal  
15       unit has a separate vacuum pump. It is understood that  
two or even three ducts may be joined so that only one  
or two vacuum pumps are required to reduce the  
atmospheric pressure in all three solvent removal units.  
Solvent removed is preferably collected, for example by  
20       condenser 38.

With reference to FIG. 4, there is shown a  
preferred screw profile suitable for use in the present  
invention. In the first barrel section 24, the screws  
21 have a return scroll element 40 which prevents  
25       material from back flowing into the drive unit 39 (FIG.  
1). The portions of the screws 21 extending through the  
remainder of the first barrel section 24, where the  
material is introduced into the extruder 10, and the  
second barrel section 25, comprise open chamber  
30       conveying elements 41 which rapidly transport the  
material downstream. Conveying elements 41 have very  
thin flights and therefore tend not to generate a  
significant amount of back pressure.

In the third barrel section 29, the screws 21 are  
35       designed to build pressure. In the embodiment shown,

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1 this is accomplished with a series of mixing elements 42  
followed by closed chamber conveying elements 43 having  
large, thick flights. The conveying elements 43 are  
followed by another series of mixing elements 42 and  
5 then a blister 44. The blister 44 has a large diameter  
to restrict the flow of material past it.

Material which has squeezed past the blister 44 is  
conveyed rapidly through the fourth barrel section 31  
and past vent opening 34 by a series of open chamber  
10 conveying elements 41. Such an arrangement maximizes  
the surface area of the material traveling through the  
fourth barrel section 31 and hence maximizes the removal  
of solvent by the first solvent removal unit 11.

At about the beginning of the fifth barrel section  
15 32, before the next vent opening 34, the screws 21  
comprise another series of mixing elements 42 followed  
by another blister 44.

In the present process, the blisters 44 may all be  
the same size, there being less of a need to increase  
20 the size of downstream blisters because the material  
becomes more viscous as it travels through the extruder.  
As material becomes more viscous it tends to build  
pressure in the extruder more readily. This tends to be  
the opposite of most extruding processes in which solid  
25 materials are fed into the extruder and the viscosity of  
the material decreases as it becomes hotter.

Material squeezing past the blister 44 is again  
carried rapidly past the vent opening 34 by open chamber  
conveying elements 41. Again, the arrangement maximizes  
30 the surface area of the material exposed to the  
atmosphere in the fifth barrel section 32 and hence  
maximizes solvent removal.

A similar arrangement of screw elements is provided  
in the sixth barrel section 33 except that kneading  
35 elements 45 are preferably used rather than mixing

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1 elements 42. The kneading elements in combination with  
a blister build pressure similar to the mixing elements  
and blister but also tend to remove any last traces of  
5 section 35, the screw 21 comprises open chamber  
conveying elements 41 which convey the material to the  
die.

The above screw profile provides an arrangement  
wherein back pressure is built up before each vent  
10 opening and then released as the material travels past  
the vent opening 34 to expose as much of the composition  
as possible to the atmosphere. While such an  
arrangement is presently preferred, it is understood  
that other arrangements may be used. It is also  
15 understood that other screw elements may be used to  
provide the desired pressure changes with the extruder.

The screw profile is preferably designed to  
maximize the surface area of the composition passing  
through the barrel sections of the solvent removal  
20 units. In addition to the surface area, solvent removal  
is dependent on the temperature of the composition, the  
atmospheric pressure within that barrel section and the  
residence time of the composition within that barrel  
section which, in turn, depends on the feed rate.

25 For a given feed rate, temperature and pressure are  
adjusted to maximize solvent removal without drawing any  
of the composition through the vent opening. Elevated  
temperatures in the range of from about 80°C to about  
150°C in combination with pressures of from about 50  
30 torr to about 150 torr are presently preferred.

In the embodiment shown in FIG. 1, material is  
extruded as a thin sheet directly onto backing films or  
webs. Rolls 47 of backing film are mounted above and  
below the sheet die 14 of the extruder 10. The thin  
35 sheet of material and the film from the rolls 47 pass

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1       between a pair of small rollers 48 and extend across a  
conveyor 49 which carries the sheet material away from  
the extruder 10 for curing.

5       One of the surprising results of the present  
process is that the extruded sheets exhibits a lower-  
than-expected free monomer level. In conventional  
drying processes, the residual free monomer level is  
about 0.5 to 2%. Moreover, the residual free monomer  
10       level tends to substantially increases as the thickness  
of the sheets increases. In many applications,  
particularly medical applications, such free monomers  
are considered undesirable impurities. In the present  
process, a residual free-monomer level of 0.1% and below  
can be achieved. Accordingly, products made by the  
15       present invention would offer distinct advantages in  
such applications.

Another surprising result is that, even at  
thicknesses as great as 1mm or more, the extruded sheet  
is bubble free.

20       It is apparent that the number of solvent removal  
units may vary. That is, a single solvent removal unit  
may be used in certain applications, particularly those  
which do not require a solvent-free extrudate.  
Alternatively, many solvent removal units may be used,  
25       for example, if it is desired to achieve a very low  
solvent or residual monomer level.

It is apparent that other compounding ingredients,  
such as plasticizers, tactifying resins, fillers, cross-  
linking agents and the like may be added to the extruder  
30       to mix with the adhesive composition.

The present process may also be utilized in a co-  
extrusion process to co-extrude thin unfilled adhesive  
skin layers over both sides of the carrier layer. Such  
a process utilizes two twin screw extruders. Each of  
35       the extruders are set up generally as described above

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1 and comprise at least one feeding unit and at least one  
solvent removal units. However, both extruders feed  
material into a single die through an adaptor.

5 With reference to FIG. 5, there is shown an adaptor  
50 suitable for such an application. The adaptor 50  
comprises a first pipe 51 extending forwardly from the  
first extruder 52 to the back of a sheet die 53 for  
carrying material from the first extruder 52 to the die  
10 53. A larger diameter second pipe 54, having a closed  
rearward end 55 is mounted concentrically around the  
first pipe 51 adjacent to the die 53. The diameter of  
the second pipe 54 is selected to form an annular space  
56 around the first pipe 51. A third pipe 57 connects  
15 the second extruder 58 to the second pipe 54 and carries  
material from the second extruder 58 to the annular  
space 56. Both of the first and second pipes 51 and 54  
open into the interior of the die 53.

In the process, a first composition comprising  
first polymer matrix, solvent and fillers, as required  
20 for forming the carrier layer, is introduced into the  
first extruder 52. Simultaneously, a second adhesive  
composition comprising second polymer matrix, e.g., a  
PSA polymer matrix, and solvent is introduced into the  
second extruder 58. Solvent is removed from each  
25 composition by the solvent removal units of the  
extruders as described above. A solvent-free first  
composition from the first extruder 52 flows into the  
die through the first pipe 51. Likewise, solvent-free  
second adhesive composition from the second extruder 58  
30 flows through the third pipe 57 and then the second  
pipes 54 and into the die as a concentric ring around  
the first adhesive composition. In the die, the  
adhesive compositions are flattened out and extruded in  
a laminated sheet construction, the first adhesive  
35 composition forming a middle carrier layer and the

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1 second adhesive compositions forming the top and bottom skin layers.

5 The skin layer increases the tack or initial adhesion of the tape. As an alternative to co-extruding a skin layer covering the entire carrier layer, the skin layer may be "co-extruded" with the carrier layer as strips or patches at the surface of the carrier layer.

10 With reference to FIGS. 6, 7 and 8, there is shown a preferred die assembly for co-extruding one adhesive material with strips of a second adhesive material on its surface. The die assembly comprises a conventional sheet die 61. The top and bottom plates 62 and 63 of the die 61 comprise a series of cylindrical bores 64. A small opening 66 connects each bore 64 with the interior of die 61.

15 The material of the carrier layer is processed through a first extruder 67 having solvent removal units as described above and is introduced into the back of die 61. The second material, e.g., a PSA polymer matrix free of microspheres and filler, is introduced into the die through an adaptor 68. The adaptor 68 comprises a pipe 69 and upper and lower manifolds 71 and 72. The upper and lower manifolds 71 and 72 cover the bores 64 in the top and bottom plates 62 and 63 of the die 61.

20 The second material is introduced into the pipe 69, flows into the upper and lower manifolds 71 and 72, into the bores 64 and through the openings 66 into the interior of the die. In such an arrangement the second adhesive is "co-extruded" with the carrier material as strips 73 on the surface of the extruded carrier material 74. The width of the strips 73 depends on the diameter of the openings 66. Likewise the depth of the strips depends on the rate at which the second material is introduced into the die through the openings. If  
30 desired, the second material may be pulsed into the die,  
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1        thus forming broken strips or patches of the second  
material at the surface of the carrier material. It is  
apparent that the outer surface of the strip 73 is  
generally coplanar with the exposed surface of the  
5        carrier material 74.

      This embodiment offers more latitude in selecting  
the second material than a co-extrusion process in which  
the second material forms a skin layer covering the  
entire surface of the carrier layer. With a skin layer  
10        covering the entire surface, the materials of the skin  
and carrier layers must exhibit good adhesion to each  
other to prevent delamination. Formation of a skin  
layer comprising strips makes that requirement less  
critical because here is greater contact area between  
15        the second material and the carrier material. Also, if  
the carrier layer comprises a PSA polymer matrix, a  
substantial amount of the surface of the carrier layer  
is exposed and thus able to form a permanent bond with  
the substrate to which it is applied.

20        The second material may be processed in a second  
extruder as described above and introduced into pipe 69  
from the second extruder. Alternatively, if the second  
material is an acrylic or rubber based hot melt adhesive  
or the like, it may be introduced into the pipe 69 by  
25        means of a gear pump or the like. Hot melt adhesives  
are presently preferred as they eliminate the need for a  
second extruder.

      If desired, the backing film may be extruded  
simultaneously with the adhesive sheet and applied  
30        directly to the surface of the adhesive sheet. Also,  
rather than a co-extrusion process as described above,  
it is apparent that the tape and backing film may be co-  
extruded using a conventional blow film extrusion  
process.

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1           For certain substrates such as PVC side moldings,  
the foam-like tape may be co-extruded with the substrate  
in a single operation.

5           The foam-like tape sheet or tape thus produced is  
preferably cured, i.e. cross-linked, by electron beam  
radiation. The carrier layer may be cured prior to or  
after lamination of the skin layers. Typical electron  
beam radiation levels range from about 10 to about 100  
kiloGray (kGy) and are preferably from about 30 to about  
10       60 kGy.

          The foam-like tapes of the present invention  
exhibit an excellent combination of rheological,  
adhesion and performance properties. For acrylic based  
PSA tapes, tensile strength, as measured by ASTM D1708,  
15       is typically in the range 0.5 to 1.3 megapascal.  
Elongation, as measured by ASTM D1708, is preferably  
from about 500 to about 1500 percent or greater. For  
rubber based PSA tapes, the tensile strength is  
typically from about 0.7 to about 2.0 megapascals and  
20       the elongation is from about 500 to about 2500%.

          For the acrylic based PSA tapes of the present  
invention, the storage modulus ( $G'$ ), measured at 0.01  
radians frequency at 25°C is at least  $10^4$  pascals and  
preferably at least  $4 \times 10^4$  pascals after electron beam  
25       curing. The loss modulus ( $G''$ ) generally measured at  
0.01 radians frequency at 25°C is at least  $10^4$  pascals  
and preferably at least  $4 \times 10^4$  after electron beam  
curing. When measured at 100 radians frequency,  $G'$  and  
 $G''$  are both less than about  $2 \times 10^6$  pascals.

30       The peel adhesion is preferably from about 1300 to  
about 3000 Newtons/m or greater for acrylic based PSA  
tapes and from about 3000 to about 12000 Newtons/meter  
or greater for rubber based PSA tapes measured by PSTC  
No. 3. In the test one side of the tape is laminated to  
35       soft 0.05 mm aluminum foil and then tested after

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1 laminating the other side to the substrate with a 6.8 kg  
roller, two passes, and then waiting for twenty minutes.  
If the peel adhesion is greater than 350 Newtons/meter,  
a 5 mil polyester film is used rather than aluminum  
5 foil.

The shear adhesion as measured by Fisher Body  
Materials Specification (FBMS) Test Method (TM) 45-124,  
is preferably at least 500 grams for acrylic PSA tapes.

10 In the following examples, certain designations and  
trade names are used. Adhesive A is an electron beam  
curable acrylic solution adhesive comprising butyl  
acrylate, 2-ethyl hexyl acrylate and acrylic acid in a  
45:41:19 mole ratio. Adhesive B is an electron beam  
curable acrylic solution adhesive comprising butyl  
15 acrylate, 2-ethyl hexyl acrylate and acrylic acid. RB  
designates a rubber based solution adhesive comprising  
about 19.3% by weight styrene-butadiene-styrene linear  
copolymer containing about 31% styrene, about 16.1% by  
weight styrene-butadiene copolymer, about 25.8% by  
20 weight alpha pinene tackifier, about 32.3% by weight  
rosin ester tackifier, and about 6.4% by weight of a  
compatible aromatic liquid resin. A-16-500 designates  
hollow glass microspheres marketed by Minnesota Mining  
and Manufacturing Co. having a true particle density of  
25 about 0.2 g/cc and a size of 20-130 microns. Q-cel 500  
designates hollow glass microspheres marketed by P.Q.  
Corp. having a true particle density of about 0.2 g/cc  
and a size of 10 to 115 microns. Cab-O-Sil M5  
designates fumed silica from Cabot Corp. Monarch 700  
30 carbon black is sold by Cabot Corp. BJO 0930 is a trade  
designation of Union Carbide Corp. for hollow phenolic  
microspheres having an average particle size of 40  
microns. SF-14 is a trade designation of PA Industries  
for hollow ceramic microspheres having a density of  
35 0.7g/cc and a particle size of 10-100 microns.

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Example I

The following compositions listed in Table I were prepared by adding the fillers to a solution of the polymer in ethylacetate/isopropanol at 50% by weight solids:

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Table I

	<u>Composition 1</u>	<u>Composition 2</u>	<u>Composition 3</u>	<u>Com. 4</u>	<u>Com.5</u>
10	Adhesive A 100g (dry wt.)	100g	————	100	100
	Adhesive B ————— (dry wt.)	————	100g	-	-
15	Glass Hollow Microspheres A-16-500 6g	6g	6g	-	-
	Q-Cel-500 —	—	—	-	4g
	Cab-O-Sil M5 4g	3g	4g	4g	4g
20	Carbon Black Monarch 700 —————	1g	————	-	0.2g
	Phenolic Hollow Microsphere BJO 0930 —————	—	————	-	2g
25	Ceramic Hollow Microsphere SF14 —————	—	————	16g	-

Each of the above compositions were coated onto a release film and dried at 70°C in an oven with forced air circulation for 20 minutes and then in a vacuum oven at 70°C for one hour. A 0.8mm thick, 20cm x 20cm carrier layer was prepared by compression molding at about 110°C using a stainless steel mold. A teflon FEP film was used to prevent the adhesive from sticking to the mold. The carrier layer was then electron beam irradiated both sides at 50 kGy using a 300 KeV ESI

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1 electron beam equipment. A high performance acrylic transfer tape AS 838X manufactured by Avery was then laminated on both sides of the carrier layer.

Composition 1 involved two different samples.

5 Sample 1 was cured open face and sample 2 was cured through a FEP release film, composition 4 also involved two different samples. The skin layers of sample 2 had a coat weight of 125 G/m<sup>2</sup> rather than 50 g/m<sup>2</sup>, as in Sample 1.

10 The dynamic mechanical properties of the tapes were evaluated using a Rheometrics dynamic mechanical spectrometer at 24°C at a frequency range of 0.1 - 300 rad/sec.

15 PVC side molding test bars from Standard products were wiped clean with 1:1 dilution of isopropanol and distilled water and dried at room temperature. The moldings were then primed with Tite-R-Bond 2287 from Norton Chemical and dried at room temperature for 12 hours. One side of the double coated tape was laminated onto the smooth surface of the side molding using 6.8 Kg weighted roller. Painted panels 51mm x 127mm (Inmont base coat/clear coat) were cleaned using isopropanol/ distilled water as above and dried. The release film was removed and the molding was attached to the panel using a 6.8 Kg weighted roller (two passes) with 25.4mm of the molding overhanging the edge of the panel. All panels were aged at room temperature for 72 hours prior to an exposure or testing. Cleavage peels were determined similar to Fisher Body TM 45-88. Accelerated aging involved 2 weeks at 82°C in an air oven. Humidity resistance was tested after exposing the panels with the side molding at 38°C and 95% humidity for one week. Gasoline resistance was tested by immersing the samples into gasoline for 10 seconds and 20 seconds dry off time. This was repeated three times. Cleavage peel

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1 was determined immediately after the final immersion.  
Initial values indicate cleavage peels immediately after  
the specified exposure and Final values refer to  
5 cleavage peels after 24 hours conditioning at room  
temperature. Creep test involve laminating a 12.7mm x  
63.5mm side molding using a 6.8Kg weighted roller on a  
panel as in cleavage peel test with 12.7mm overhanging  
and attaching a 500g weight at the free end of the  
10 molding and immediately placing the sample in the oven  
for 96 hours at 70°C. Tensile strength and elongation  
at break were determined using a dumbbell specimen  
similar to the ASTM D 1708.

The results are shown in Table II below. The  
results shown are an average of at least two duplicate  
15 tests.

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TABLE VI

	Composition 1 Sample 1	Comp. 2	Comp. 3	Comp. 4 Sample 2	Comp. 5
CLEAVAGE PEEL BREAKAWAY	121±14	82±14	80±14	86	74
CONTINUOUS	36±7	32±9	30±9	28	40
ACCELERATED AGING INITIAL (N/12.7MM) BREAKAWAY	68	50±14	62±14	92	76
CONTINUOUS	25±7	40±9	30±0	62	47
FINAL (N/12.7MM) *	188±14	153±14	132±14	147	183
CONTINUOUS	62±7	60±9	60±9	89	84
HUMIDITY INITIAL (N/12.7MM) BREAKAWAY	130±14	90±14	100±14	84	70
CONTINUOUS	63±7	50±9	40±9	40	40
FINAL (N/12.5MM) 8*	158±14	95±14	95±14	90	90
CONTINUOUS	70±7	50±9	42±9	48	50
GASOLINE INITIAL (N/12.5MM) BREAKAWAY	130±14	88±14	90±14	74	77
CONTINUOUS	38±7	30±9	30±9	36	38
STRENGTH (MIL) 70 DEG.C TENSILE STRENGTH (KPa) ELONGATION (%)	166±39 900 700	166±39 900 700	166±39 900 700	95±45 - -	95±45 - -
STORAGE MODULUS (G') (Pa) at 0.1 radians freq. at 100 radians freq.	1.5x10 <sup>5</sup> 9x10 <sup>5</sup>	- -	- -	- -	- -
LOSS MODULUS (G'') (Pa) at 0.1 radians freq. at 100 radians freq.	4x10 <sup>4</sup> 8x10 <sup>5</sup>	- -	- -	- -	- -

\*Final values refer to the adhesion after recovering at 23°C for 24 hours.

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Example II

A rubber based carrier layer was prepared by mixing as a solution in toluene at 50% by weight solids 90.4% by weight (dry weight) RB rubber based adhesive, 0.3% by weight trimethylolpropanetrithioglycolate (TMPTG), as a cross-linking additive and 9.3% by weight (32% by volume) hollow glass A-16-500 microspheres. The solvent was stripped off by vacuum and a 0.8 mm carrier layer was prepared by compression molding. A release liner, was used to prevent the carrier layer from sticking to the sides of the mold.

The rubber carrier layer thus prepared was electron beam irradiated on both sides at 300 kv, open faced under nitrogen. The process was repeated and a high performance rubber adhesive transfer tape was laminated on each side of the carrier layer to provide an adhesive coat weight of about 50 g/m<sup>2</sup> and electron beam irradiated at 50 kGy dose.

Tensile test specimens were cut out from the uncoated and double-coated samples and tested in a manner similar to the acrylic tapes of Example I. The results are shown in Tables III and IV below.

Table III

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PROPERTIES OF UNCOATED RUBBER-BASED CARRIER

<u>LAYER</u>	<u>TENSILE</u>	<u>ELONGATION</u>	<u>180° PEEL ON</u>	
<u>EB DOSE</u>	<u>STRENGTH</u>	<u>(%)</u>	<u>SS</u>	<u>PE</u>
<u>(kGy)</u>	<u>(kPa)</u>			
0	1000	1700	2400 P	1200 P
30	1600	1600	1700 P	1100 P
50	1300	1200	1900 P	- -

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Table IVPROPERTIES OF DOUBLE-COATED RUBBER-BASED TAPE

EB DOSE (kGy)	TENSILE STRENGTH (kPa)	ELONGATION (%)	180° PEEL ON	
			SS	PE
0	1300	1800	>3900*	2000 P
30	1700	1900	>3900*	2300 P
50	1500	1700	>3900*	2200 P

10

P = CLEAN PANEL FAILURE  
 SS = STAINLESS STEEL  
 PE = POLYETHYLENE  
 \* value at which the face stock  
 aluminum tore

Example III

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A rubber-based composition was prepared as in Example II comprising 90.8% by weight (dry weight) RB adhesive, 3.6% by weight Q-cel 500 glass hollow microsphere, 1.8% by weight BJO 0930 hollow phenolic microspheres, 3.6% by weight Cab-O-Sil and 0.2% by weight Carbon Block, Monarch 700. The solvent was stripped off by vacuum and a 0.8 mm carrier layer was prepared by compression molding. A release liner, was used to prevent the carrier layer from sticking to the sides of the mold. The process was repeated and a high performance rubber adhesive transfer tape was laminated on each side of the carrier layer to provide an adhesive coat weight of about 50 g/m<sup>2</sup>. Peel adhesive was measured after laminating one side of the tape to 0.127 mm Mylar.

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The carrier layer by itself demonstrated a peel strength of 5300 N/m on a stainless steel substrate and 2960 N/m on a polyethylene substrate. The double coated tape exhibited a peel strength of 9400 N/m on a stainless steel substrate and 3130 N/m on a polyethylene substrate.

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1           It is expected that the above samples could be  
formulated with 0.6% TMPTG for electron beam curing to  
improve high temperature performance without adversely  
affecting the above demonstrated peel strength.

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#### EXAMPLE IV

A double-coated adhesive tape as prepared by  
dissolving a solution of Adhesive A in  
heptane/isopropanol alcohol (90:10) to provide a  
10 composition having 47.6% by weight solids. 137 grams of  
the composition was blended with 105 grams (37.2% by  
weight solids in heptane) of solids tacky microspheres  
prepared by the droplet suspension polymerization method  
disclosed in Example 2 of U.S. patent application Serial  
15 No. 138,509. The mixture was coated onto a release  
liner to a thickness of about 5 mils. The solvents were  
then removed by drying the film in an oven at 70°C for  
20 minutes and then in a vacuum oven at 80°C for 30  
minutes. A one millimeter carrier sheet was prepared by  
20 compression molding the dried mixture between two teflon  
FEP film using a stainless steel plate in a hydraulic  
press at 100°C. The formed sheet was then irradiated at  
50 KG eb dose using a 2.5 MeV electron beam device. A  
skin layer of adhesive was then laminated on each side  
25 of the carrier layer. The skin layer was made of  
Adhesive A containing 0.2% by weight  
glycidylmethacrylate comonomer and was applied in a  
thickness of 50 grams per square meter and was EB cured  
at 50 KGy dose.

30           The physical properties of the tape were then  
evaluated for side molding application and are shown in  
Table V below.

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### EXAMPLE V

Another double-coated foam tape was prepared by dissolving a solution of Adhesive A in heptane/isopropanol alcohol (90:10) to provide a composition comprising 47.6% by weight solids. 179 grams of the composition was blended with 80 grams (37.2% by weight solids in heptane) of solid, tacky microspheres prepared by the droplet suspension polymerization method of Example 2 of U.S. patent application Serial No. 138,509. The solvents were removed by drying the mixture as a film in an oven at 70°C for 20 minutes and then in a vacuum oven at 80°C for 30 minutes. A one millimeter thick carrier sheet was prepared by compression molding the dry mixture between two teflon FEP films using a stainless steel plate in a hydraulic press at 100°C. The sheet was then irradiated at 50 KGy does using a 2.5 MeV electron beam device. A skin layer made of Adhesive A was laminated on both sides of the tape at a thickness of 50 grams per square meter.

The properties of the tape were evaluated for side molding application and are shown in Table V below. A cold slam test as described in FBMS 45-89 was also conducted. The tape passed the cold slam test at  $-20^{\circ}\text{C}$ , with all test samples remaining on the panel after 10 slams. At  $-30^{\circ}\text{C}$ , three out of four samples stayed on the panel after 10 slams.

### TABLE V

Example	90° Peel	72 Hrs.		Gasoline		Aging		Creep
	Adhesion (N/M)	Rm Temp (N/12.7 mm)		(N/12.7 mm)		(N/12.7 mm)		
		B	C	B	C	B	C	
A	1370 P	93 P	45 P	91 P	46 P	110 AD/F	48 AD/F	346+Ks
B	1200 P	71 P	36 P	80 P	38 P	130 AD/F	65 AD/F	346+Ks

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1      B    = Breakaway  
      C    = Continuous  
      P    = Panel failure  
      AD/F = Adhesive failed from foam due to poor anchorage.

### EXAMPLE VI

5 A sheet die was mounted on a ZE40-A,33L/D Berstorff extruder generally as shown in FIG. 1 having seven barrel sections. A feed unit was mounted in the first section. The screw profile of the extruder is shown specifically in FIG. 9. Here screw element 61 is a return scroll. Screw elements 62 are three-flight conveying elements, specifically Berstorff No. 60-1-3. Screw elements 63 are mixing elements, specifically Berstorff No. ZS-10-12. Screw elements 64 are two-flight conveying elements, specifically Berstorff No. 40-1-2. Screw elements 65 and 66 are blisters, specifically Berstorff 39 and 42 respectively. Screw elements 67 are kneading elements, specifically Berstorff No. KS-9-RE.

20 The extruder was set up with three solvent removal  
units involving the fourth, fifth and sixth barrel  
sections respectively. Each barrel section had a large  
vent opening. An 1.5 to 2 inch duct connected each of  
the vent openings to a vacuum pump. An Ochsner vacuum  
25 pump with a suction capacity of 120 cc/hr was used in  
the first solvent removal unit to reduce the atmospheric  
pressure in the fifth barrel section and a Busch two-  
stage oil pump was used in the second and third solvent  
removal units to reduce the atmospheric pressure in the  
30 sixth and seventh barrel sections. Solvent removed by  
the solvent removal units were condensed and collected  
using a Busch condenser.

35 Trial runs involving three adhesive compositions were performed. Each had 63% solids, the remainder being ethylacetate solvent. The solids of the first

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1 composition consisted of Adhesive B adhesive only. The  
second consisted of 91% dry weight Adhesive B adhesive  
and 9% by weight hollow phenolic microspheres. The  
second composition was similar to the first except that  
5 the hollow microspheres were glass rather than phenolic.

In each trial, the adhesive composition was heated  
to a temperature of about 60°C and gravity fed through a  
two-inch pipe into the hopper of the extruder feed unit.  
This produced a feed rate and production rate of up to  
10 about 32 lb/hr. The temperature of the first barrel  
section or feed zone was about 100°C. The temperature  
of the second and third barrel sections was also about  
100°C. The temperature of the fourth, fifth and sixth  
barrel sections was from about 120° to about 150°C. The  
15 die temperature was from about 120 to about 140°C and  
the melt temperature was about 124°C to about 140°C.  
The extruder drive was operated at 70 to 214 rpm. The  
vacuum pumps maintained an atmospheric pressure in all  
three solvent removal units of approximately 70 torr.  
20 Approximately 80% by volume of the solvent was removed  
by the first solvent removal unit. Approximately 18% to  
19% by volume of the solvent was removed by the second  
solvent removal unit and approximately 1% to 2% by  
volume of the solvent was removed by the third solvent  
25 removal unit. The amount of residual solvent remaining  
in all of the compositions was less than about 1%. The

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1 amount of residual free-monomer was found to be less  
than 0.1%.

#### EXAMPLE VII

5 A 750 millimeter sheeting die was fitted onto a  
Berstorff 90 millimeter corotating twin screw extruder.  
The extruder had seven barrel sections. A feed unit was  
mounted on the first barrel section. The screw profile  
of the extruder is shown schematically in FIG. 10.  
10 Here, screw element 71 is a return scroll. Screw  
elements 72 are triple flight conveying elements,  
specifically Berstorff No. 125-1-3. Screw element 73 is  
a single flight conveying element, specifically  
Berstorff No. 125-1-S. Screw elements 74 are double  
15 flight conveying elements, specifically Berstorff No.  
125-1-2. Screw elements 75 are mixing elements,  
specifically Berstorff No. 2S-15-25. Screw elements 76  
are blisters, specifically Berstorff Blister 88. Screw  
element 77 is a single flight conveying element,  
20 specifically Berstorff No. 100-1-S and screw elements 78  
are double flight conveying elements, specifically  
Berstorff No. 100-1-2. Screw elements 79 and 80 are  
kneading elements, specifically Berstorff Nos. KS-23-RE  
and A-KS-23-RE. Finally, screw elements 81 and 82 are  
25 double flight conveying elements, specifically Berstorff  
Nos. A-125-1-2 and A-100-2 respectively.

Three solvent removal units were set up involving  
the fourth, fifth and sixth barrel sections, each having  
a large vent opening. A two inch diameter duct  
30 connected each barrel section of a solvent removal unit  
with a vacuum pump. A 25 horsepower liquid ring pump  
used to reduce the atmospheric pressure in all three  
barrel sections of the solvent removal units. Solvent  
removed by the solvent removal units was condensed and  
35 collected using a condenser.

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1 Trial runs were performed involving three adhesive  
compositions. All three compositions had 62% solids,  
i.e., 38% by volume solvent which was ethylacetate, etc.  
The solids of the first adhesive composition consisted  
5 of Adhesive A adhesive only. The solids of the second  
adhesive composition consisted of 91% dry weight  
Adhesive A, 5.4% by weight Q-Cel 500 hollow glass micro-  
spheres and 3.6% by weight Cab-O-Sil M5 fumed silica.  
The solids of the third composition consisted of 91% dry  
10 weight Adhesive A, 5.4% by weight, Q-Cel 500 hollow  
glass microspheres, 3.2% by weight Cab-O-Sil M5 and 0.4%  
by weight carbon black Monarch 500.

For the second and third compositions above, the  
fillers were pre-blended and fed simultaneously with the  
15 adhesive diluted with solvent to the feed unit of the  
extruder. The fillers were fed by an Acrison Volumetric  
Feeder, and the diluted adhesive was fed by gravity from  
two drums.

The temperature of the feed zone (first barrel  
20 section) was maintained at 58 to 67°C; the second  
section at 84 to 123°C; the third section at 100 to  
153°C; the fourth section at 100 to 155°C; the fifth  
section at 104 to 148°C; and the sixth section at 144 to  
154°C. The die temperature was 107 to 165°C and the  
25 melt temperature was 107 to 157°C. The extruder drive  
was operated at 100 to 120 rpm. The output ranged from  
60 to 150 lbs/hr.

As the adhesive composition was conveyed through  
the extruder, approximately 80% of the solvent was  
30 removed in the first solvent removal unit, approximately  
12% removed in the second solvent removal unit, and 1%  
removed in the third solvent removal unit.

Adhesive sheet material was extruded as a sheet  
approximately 22 inches wide and 20 to 70 mil thick.  
35 The sheet was extruded onto an FEP release film.

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EXAMPLE VIII

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A ZE90/90A Berstorff corotating twin screw extruder was set up as described in Example VII with a feed unit at the first barrel section and solvent removal units at the fourth, fifth and sixth barrel sections. A ZE40/40A Berstorff corotating twin screw extruder as described in Example 1 and having approximately 1/10 the capacity of the ZE90/90A extruder was set up at a right angle to the ZE90/90A extruder. The ZE40/40A extruder had a feed unit at the first barrel sections but only two solvent removal units, involving the fourth and fifth barrel sections. The ZE40/40A extruder was joined to the ZE90/90A extruder by an adapter generally as shown in FIG. 5.

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A first composition was prepared comprising 53% solids including 91% dry weight Adhesive A adhesive, 5.4% by weight glass microspheres and 3.6% by weight fumed silica. The solvent was a 20:80 mixture of isopropanol and ethyl acetate. A second composition was prepared having 53% solids, the solids comprising Adhesive A adhesive only and the solvent comprising a 20:80 mixture of isopropanol and ethyl acetate.

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The first composition was introduced into the ZE90/90A extruder and the second composition was introduced into the ZE40/40A extruder. The ZE90/90A extruder was driven at 140 rpm and the temperature in the second through seventh barrel sections was 102°C, 102°C, 129°C, 131°C, 122°C and 118°C, respectively. The die temperature was 116°C and the melt temperature was 117°C. The ZE40/40A extruder was driven at 197 rpm and the temperatures of the second through seventh barrel sections was 100°C, 100°C, 120°C, 147°C, 186°C and 148°C. The melt temperature was 135°C. The solvent removal units for both extruders was maintained at 120 millibar.

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1           From this arrangement, a double-coated PSA foam  
tape was co-extruded at a 200 lb./hr. rate, 20 lb./hr.  
from the ZE40/40A extruder. The product had a middle  
5           foam layer of the first composition and skin layers of  
the second composition. The amount of residual solvents  
in the product was less than 0.1%.

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1     WHAT IS CLAIMED IS:

5           1.     An adhesive tape having a carrier layer comprising an electron beam-cured polymer matrix, from about 5% to about 70% by volume low density microspheres and at least one pigment in an amount sufficient to impart color to the tape.

10          2.     An adhesive tape as claimed in claim 1 wherein the polymer matrix is a pressure sensitive adhesive polymer matrix.

15          3.     An adhesive tape as claimed in claim 1, wherein the carrier layer has a thickness of from about 0.25 to about 4.0 mm.

20          4.     An adhesive tape as claimed in claim 1, wherein the carrier layer comprises from about 5% to about 45% by volume low density microspheres.

          5.     An adhesive tape as claimed in claim 1, wherein the carrier layer comprises from about 10 to about 20% by volume low density microspheres.

25          6.     An adhesive tape as claimed in claim 1, wherein the low density microspheres are hollow.

30          7.     An adhesive tape as claimed in claim 1, wherein the low density microspheres are made from a material selected from the group consisting of glass, ceramic, polymeric and carbon materials and mixtures thereof.

35          8.     An adhesive tape as claimed in claim 7, wherein the low density microspheres are ceramic.

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1           9. An adhesive tape as claimed in claim 7,  
wherein the low density microspheres are carbon.

5           10. An adhesive tape as claimed in claim 7,  
wherein the low density microspheres are made of a  
polymeric material.

10          11. An adhesive tape as claimed in claim 10,  
wherein the polymeric material is selected from the  
group of phenolic polymers and PVDC copolymers.

15          12. An adhesive tape as claimed in claim 10,  
wherein the polymeric material is an inherently tacky,  
infusible, pressure sensitive adhesive polymer.

13          13. An adhesive tape as claimed in claim 1,  
wherein the pigment is carbon black.

20          14. An adhesive tape as claimed in claim 13,  
wherein the carbon black is present in an amount of from  
about 0.25% to about 5% by weight.

25          15. An adhesive tape as claimed in claim 1,  
wherein the carrier layer further comprises fumed silica  
in an amount of up to about 10% by weight.

30          16. An adhesive tape as claimed in claim 15,  
wherein the fumed silica is present in the carrier layer  
in an amount of from about 3 to about 5% by weight.

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1           17.    An adhesive tape as claimed in claim 1,  
              wherein the carrier layer further comprises up to about  
              5% by weight small, rigid high density, solid  
5           microspheres having a density of more than about 1.0  
              g/cc and an average diameter of less than about 10  
              microns.

              18.    An adhesive tape as claimed in claim 17,  
              wherein the small, rigid high density, solid  
10           microspheres have an average diameter of from about 0.1  
              to about 5 microns.

              19.    An adhesive tape as claimed in claim 1,  
              wherein the carrier layer has an elongation of at least  
15           about 500 percent and a tensile strength of at least  
              about 0.5 to 1.3 megapascals.

              20.    An adhesive tape as claimed in claim 1,  
              wherein the carrier layer has a storage modulus of at  
20           least about  $10^4$  pascals at 0.01 radians frequency and no  
              more than about  $5 \times 10^6$  pascals at 100 radians frequency  
              and a loss modulus of at least  $10^4$  pascals at 0.01  
              radians frequency and no more than about  $5 \times 10^6$  pascals  
              at 100 radians frequency.

25           21.    An adhesive tape as claimed in claim 14,  
              wherein the carrier layer has a storage modulus of at  
              least  $4 \times 10^4$  pascals at 0.01 radians frequency and no  
              more than about  $2 \times 10^6$  pascals at 100 radians frequency  
30           and a loss modulus of at least about  $2 \times 10^4$  pascals at  
              0.01 radians frequency and at least about  $2 \times 10^6$   
              pascals at 100 radians frequency.

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1           22. An adhesive tape as claimed in claim 2,  
            wherein the pressure sensitive adhesive polymer matrix  
            is acrylic based.

5           23. An adhesive tape as claimed in claim 22,  
            wherein the peel adhesion is from about 1300 to about  
            3000 newtons/meter.

10           24. An adhesive tape as claimed in claim 2,  
            wherein the pressure sensitive adhesive polymer matrix  
            is rubber based.

15           25. An adhesive tape as claimed in claim 24,  
            wherein the peel adhesion is at least about 3000  
            newtons/meter.

            26. An adhesive tape as claimed in claim 25 wherein  
            the peel adhesion is at least about 9000 newtons/meter.

20           27. An adhesive tape as claimed in claim 1,  
            further comprising a skin layer coated on to at least  
            one side of the carrier layer, said skin layer  
            comprising an adhesive polymer matrix substantially free  
            of low density microspheres.

25           28. An adhesive tape as claimed in claim 27,  
            wherein the skin layer has a coating thickness of from  
            about 25 to about 125 grams/m<sup>2</sup>.

30           29. An adhesive tape as claimed in claim 1 further  
            comprising a skin layer coated onto at least one side of  
            the carrier layer, said skin layer comprising a heat  
            activatable adhesive substantially free of rigid, low  
            density microspheres.

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1           30. A pressure sensitive adhesive tape comprising  
a carrier layer having a thickness of from about 0.25 to  
about 4.0 millimeters and a skin layer having a coating  
thickness of at least about 25 g/m<sup>2</sup> on at least one side  
5 of the carrier layer, said carrier layer comprising a  
cross-linked polymer matrix, from about 5% to about 70%  
by volume low density microspheres and a colored pigment  
in an amount of from about 0.25% to about 5% by weight,  
said skin layer comprising a pressure sensitive adhesive  
10 polymer matrix substantially free of rigid, low density  
microspheres.

          31. A pressure sensitive adhesive tape as claimed  
in claim 30, wherein the carrier layer comprises from  
15 about 10 to about 45% by volume low density  
microspheres.

          32. A pressure sensitive adhesive tape as claimed  
in claim 30, wherein the carrier layer further comprises  
20 fumed silica in an amount of up to about 10% by weight.

          33. A pressure sensitive adhesive tape as claimed  
in claim 32, wherein the fumed silica is present in the  
carrier layer of an amount of from about 3 to about 5%  
25 by weight.

          34. A pressure sensitive adhesive tape as claimed  
in claim 30, wherein said tape has an elongation of at  
least about 300%, a tensile strength of at least 0.5  
30 megapascals, a storage modulus of at least about 10<sup>4</sup>  
pascals at 0.01 radians frequency and no more than about  
2 X 10<sup>6</sup> pascals at 100 radians frequency and a loss  
modulus of at least 10<sup>4</sup> pascals at 0.01 radians  
frequency and no more than about 2 x 10<sup>6</sup> pascals at 100  
35 radians frequency.

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1        35. A pressure sensitive adhesive tape as claimed  
in claim 34, wherein the tape has a storage modulus of  
at least  $4 \times 10^4$  pascals at 0.01 radians frequency and  
5        no more than about  $2 \times 10^6$  pascals at 100 radians  
frequency and a loss modulus of at least about  $2 \times 10^4$   
pascals at 0.01 radians frequency and no more than about  
2 X  $10^6$  pascals at 100 radians frequency.

10       36. A pressure sensitive adhesive tape as claimed  
in claim 30 wherein the polymer matrix is a pressure  
sensitive adhesive polymer matrix.

15       37. A pressure sensitive adhesive tape as claimed  
in claim 36, wherein the pressure sensitive adhesive  
polymer matrix is acrylic based and the peel adhesion is  
from about 1300 to about 3000 newtons/meter.

20       38. A pressure sensitive adhesive tape as claimed  
in claim 36, wherein the pressure sensitive adhesive  
polymer matrix is rubber based and the peel adhesion is  
at least about 3000 newtons/meter.

25       39. A pressure sensitive adhesive tape as claimed  
in claim 38 wherein the peel adhesion is at least about  
9000 newtons/meter.

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1           40. A pressure sensitive adhesive tape comprising  
a carrier layer having a thickness of from about 0.25 to  
about 4.0 millimeters and a skin layer having a coating  
thickness of at least about 25 g/m<sup>2</sup> on each side of the  
5 carrier layer, said carrier layer comprising an electron  
beam-cured pressure sensitive adhesive polymer matrix,  
from about 10% to about 70% by volume low density  
microspheres selected from the group consisting of  
glass, ceramic, polymeric and carbon materials and  
10 mixtures thereof, a pigment in an amount of from about  
0.25% to about 5% by weight; and wherein said skin layer  
comprises a pressure sensitive adhesive matrix  
substantially free of rigid, low density microspheres.

15           41. A pressure sensitive adhesive tape as claimed  
in claim 37, wherein the low density microspheres are  
ceramic.

20           42. A pressure sensitive adhesive tape as claimed  
in claim 37, wherein the low density microspheres are  
carbon.

25           43. A pressure sensitive adhesive tape as claimed  
in claim 40, wherein the low density microspheres are  
made of a polymeric material.

30           44. A pressure sensitive adhesive tape as claimed  
in claim 43, wherein the polymeric material is selected  
from the group of phenolic polymers and PVDC copolymers.

35           45. A pressure sensitive adhesive tape as claimed  
in claim 43, wherein the polymeric material is an  
inherently tacky, infusible, pressure sensitive adhesive  
polymer.

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1           46.    A process for producing curable adhesive material, said process comprising:

                  introducing into an extruder an adhesive composition comprising a curable polymer matrix and  
5           solvent for the adhesive matrix.

                  conveying the adhesive composition through the extruder;

                  reducing the atmospheric pressure in at least one section of the extruder sufficiently to evaporate at  
10           least a portion of the solvent in the adhesive composition conveyed through that section;

                  removing the evaporated solvent from the extruder; and

                  extruding a solvent-reduced curable  
15           adhesive material through a die.

                  47. A process as claimed in claim 46 wherein the solvent is present in the composition in an amount of  
20           from about 20% to about 60% by volume of the composition;

                  48. A process as claimed in claim 46, wherein substantially all of the solvent is removed from the  
25           adhesive composition so that a solvent-free adhesive material is produced.

                  49. A process as claimed in claim 46 wherein the extruded adhesive material has residual free-monomer  
30           concentration of less than about 0.1% by weight.

                  50. A process as claimed in claim 46 wherein the extruded adhesive material is essentially free of  
35           bubbles.



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1           51. A process as claimed in claim 46, wherein the  
adhesive composition is heated to a temperature of from  
about 100°C to about 160°C as it is conveyed through the  
extruder.

5           52. A process as claimed in claim 46, wherein the  
atmospheric pressure is reduced in at least two sections  
of the extruder sufficiently to evaporate at least a  
portion of the solvent in the adhesive composition  
10 conveyed through each section.

          53. A process as claimed in claim 46 further  
comprising electron beam curing the extruded adhesive  
material.

15           54. A process for producing curable pressure  
sensitive adhesive material, said process comprising:  
          providing a twin screw extruder having at  
least one upstream feed unit and at least one downstream  
20 solvent removal unit, said solvent removal unit  
comprising a barrel section having a large vent opening,  
a vacuum pump, and a duct surrounding the vent opening  
and extending from the barrel section to the vacuum pump  
whereby the vacuum pump can be activated to reduce the  
25 atmospheric pressure within the barrel section, vent  
opening and duct;

          introducing into the feed unit of the extruder  
an adhesive composition comprising a curable adhesive  
polymer matrix and a solvent for the adhesive polymer  
30 matrix, said solvent being present in an amount of from  
about 20% to about 60% by volume of the adhesive  
composition;

          heating the composition and conveying the  
composition through the extruder;

35           activating the vacuum pump to reduce the

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1 atmospheric pressure in the barrel section of the  
solvent removal unit sufficiently to evaporate at least  
a portion of the solvent in the adhesive composition  
conveyed through that section; and  
5 extruding curable adhesive material through  
die.

10 55. A process as claimed in claim 54, wherein the  
extruder comprises at least two solvent removal units.

56. A process as claimed in claim 54, wherein the  
extruded curable adhesive material is solvent-free.

15 57. A process as claimed in claim 54 wherein the  
residual free-monomer concentration of the extruded  
curable adhesive material is less than about 0.1% by  
weight.

20 58. A process as claimed in claim 54, wherein the  
adhesive composition is heated to a temperature of from  
about 100°C to about 160°C as it is conveyed through the  
extruder and the pressure in the solvent removal units  
is reduced from about 150 to about 100 torr.

25 59. A process as claimed in claim 54 wherein the  
adhesive composition comprises at least one filler and  
wherein the filler is introduced into the extruder  
separately from the curable adhesive polymer matrix and  
solvent.

30 60. A process as claimed in claim 59 wherein the  
filler is selected from the group consisting of low  
density microspheres, pigments, fumed silica and  
mixtures thereof.

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1           61. A process as claimed in claim 59 wherein the  
extruder comprises a downstream feed unit and the  
curable pressure sensitive adhesive polymer matrix and  
solvent are introduced into the upstream feed unit and  
5           the filler is introduced in the downstream feed unit.

          62. A process as claimed in claim 61 wherein the  
downstream feed unit is located downstream from the  
solvent removal units.

10

          63. A process as claimed in claim 59 wherein the  
upstream feed unit comprises a first feed port on the  
lower side of the extruder and a second feed port on the  
upper side of the extruder and wherein the curable  
15           adhesive polymer matrix and solvent are introduced into  
the extruder through the first feed port and the filler  
is introduced through the second feed port.

          64. A process as claimed in claim 54 further  
20           comprising:

                  providing a second twin screw extruder having  
at least one upstream second feed unit and at least one  
downstream second solvent removal unit, said second  
solvent removal unit comprising a barrel section having  
25           a large vent opening, a vacuum pump, and a duct  
surrounding the vent opening and extending from the  
barrel section to the vacuum pump whereby the vacuum  
pump can be activated to reduce the atmospheric pressure  
within the barrel section, vent opening and duct;

30                   connecting the first and second extruders so  
that product from both extruders are extruded through a  
single die;

                  introducing into the feed unit of the second  
extruder a second adhesive composition comprising a  
35           second curable adhesive polymer matrix and solvent for

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1 the second adhesive polymer matrix, said solvent being  
present in an amount of from about 20% to about 60% by  
volume of the second adhesive composition;

5 heating the second composition and conveying  
the second composition through the second extruder;

activating the vacuum pump of the second  
solvent removal unit to reduce the atmospheric pressure  
in the barrel section of the second solvent removal unit  
sufficiently to evaporate at least a portion of the  
10 solvent in the second adhesive composition conveyed  
through that section; and

co-extruding curable adhesive having at least  
one layer of the first adhesive composition with reduced  
solvent content and at least one layer of the second  
15 adhesive composition having reduced solvent content.

65. A process as claimed in claim 64 wherein the  
extruded curable adhesive is solvent free.

20 66. A process as claimed in claim 64 wherein the  
extruded curable adhesive has a residual monomer  
concentration of less than about 0.1% by weight.

25 67. A process as claimed in claim 64 wherein the  
curable adhesive is extruded as a sheet comprising a  
middle layer of the first adhesive composition with  
reduced solvent content and two skin layers of the  
second adhesive composition with reduced solvent  
content.

30 68. A process as claimed in claim 67 wherein the  
first adhesive composition comprises low density  
microspheres and the second adhesive composition is  
essentially free of rigid, low density microspheres.

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1           69. A process as claimed in claim 64 further comprising electron beam curing the extruded curable adhesive.

5           70. A process as claimed in claim 54 wherein the die is a sheet die and comprises spaced-apart upper and lower plates forming a chamber therebetween and wherein at least one of the upper and lower plates comprises one or more of holes extending from the outer surface of the  
10 plate into the chamber, said sheet die further comprising a manifold mounted on the exterior surface of at least one of the upper and lower plates in surrounding relation to the holes, and wherein the process further comprises:

15           introducing into the manifold, a second adhesive composition; and

              co-extruding a sheet of curable adhesive material comprising a carrier layer of the first adhesive composition with reduced solvent content and  
20 strips of the second adhesive composition at the surface of the carrier layer.

              71. A process as claimed in claim 70 wherein the strips are broken, forming patches of the second  
25 adhesive composition at the surface of the carrier layer.

              72. A process as claimed in claim 54 wherein at least a portion of the screws of the twin screw extruder  
30 are intermeshing.

              73. A process as claimed in claim 54 wherein at least a portion of the screws of the twin screw extruder are tangential.  
35

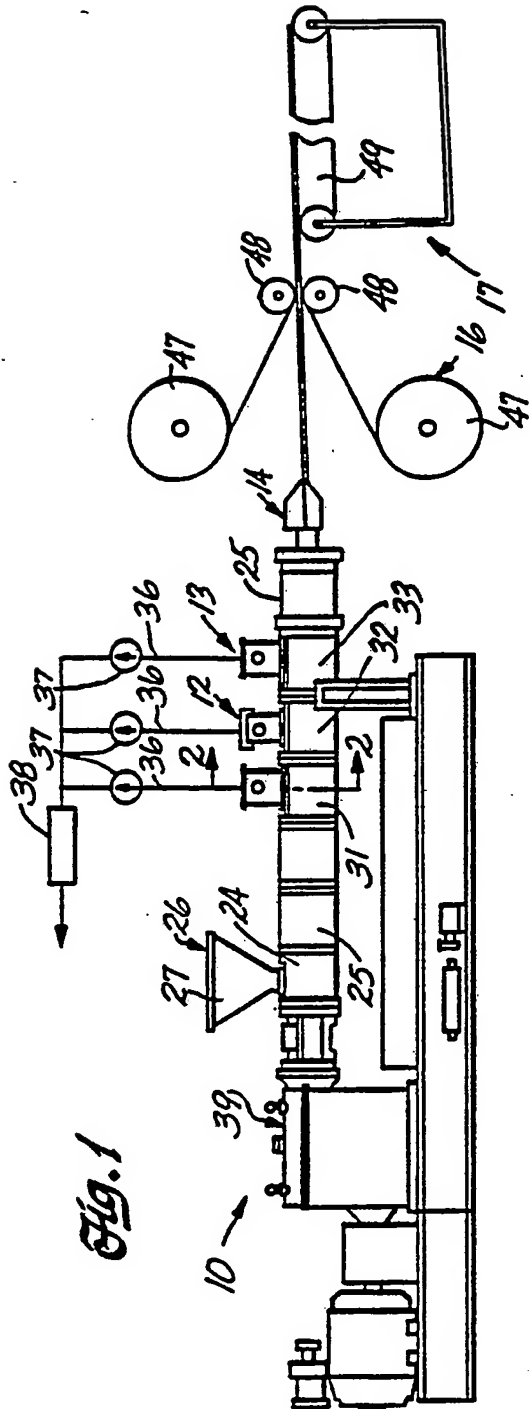


Fig. 1

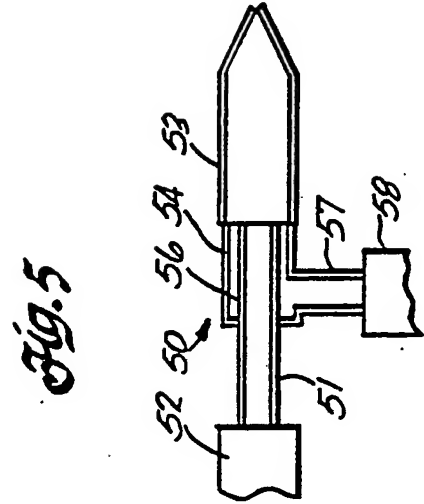


Fig. 5

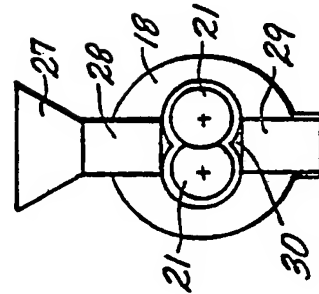


Fig. 3

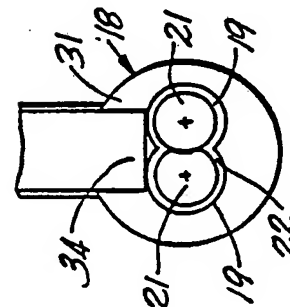
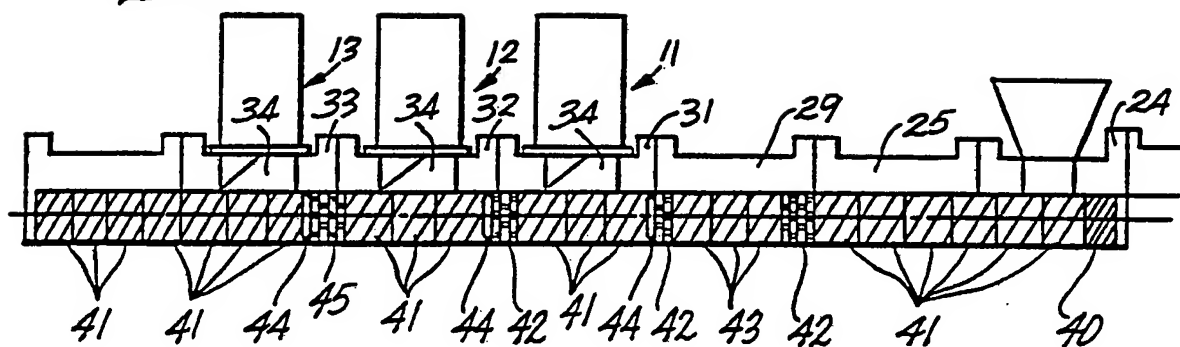
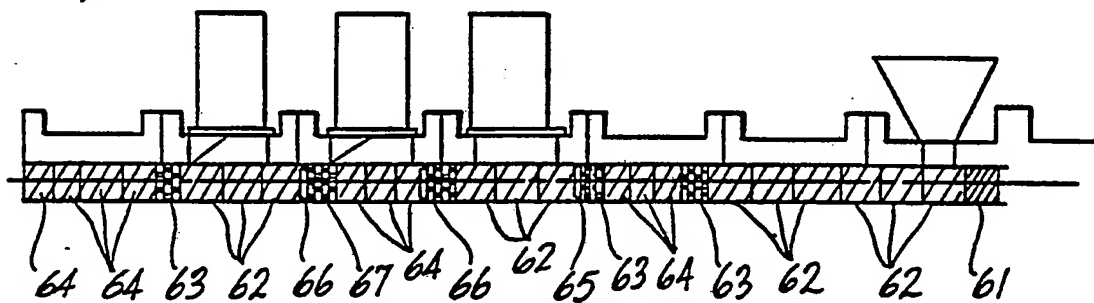
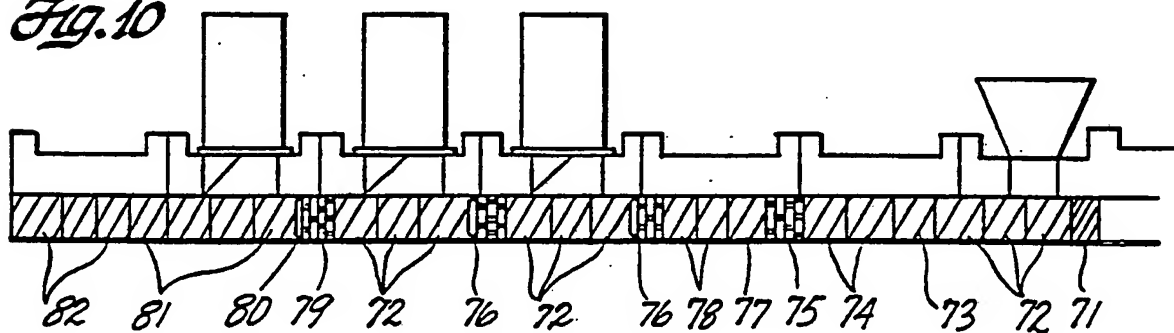
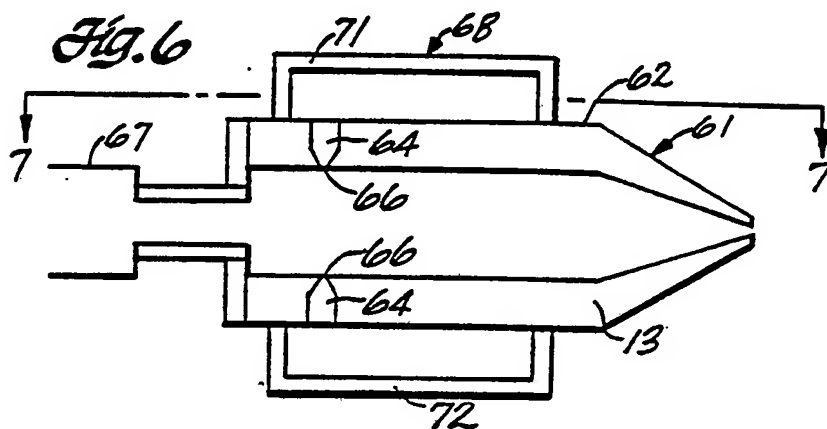
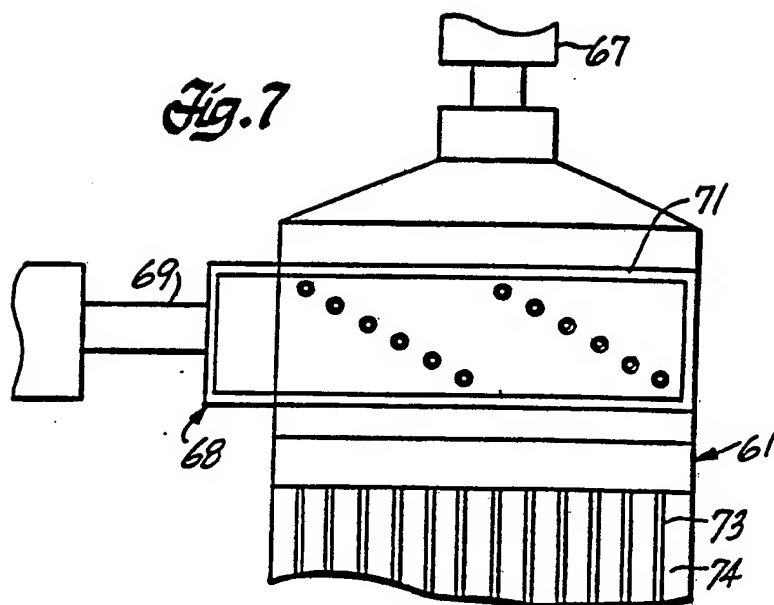


Fig. 2

*Fig. 4**Fig. 9**Fig. 10***SUBSTITUTE SHEET**



**SUBSTITUTE SHEET**



# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US88/02193

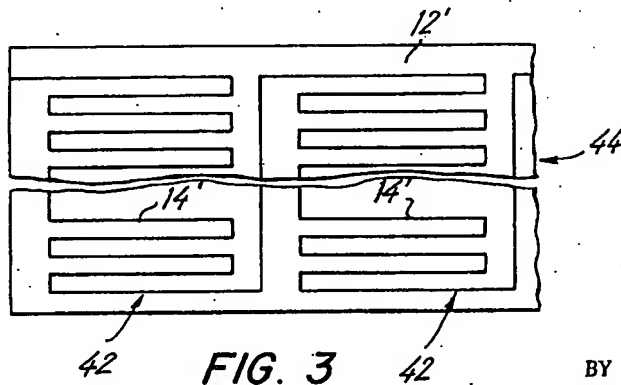
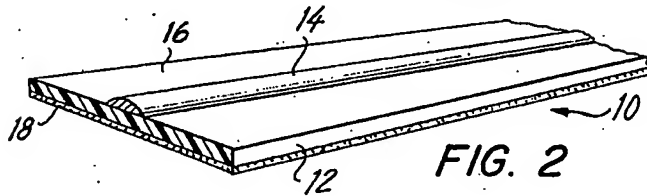
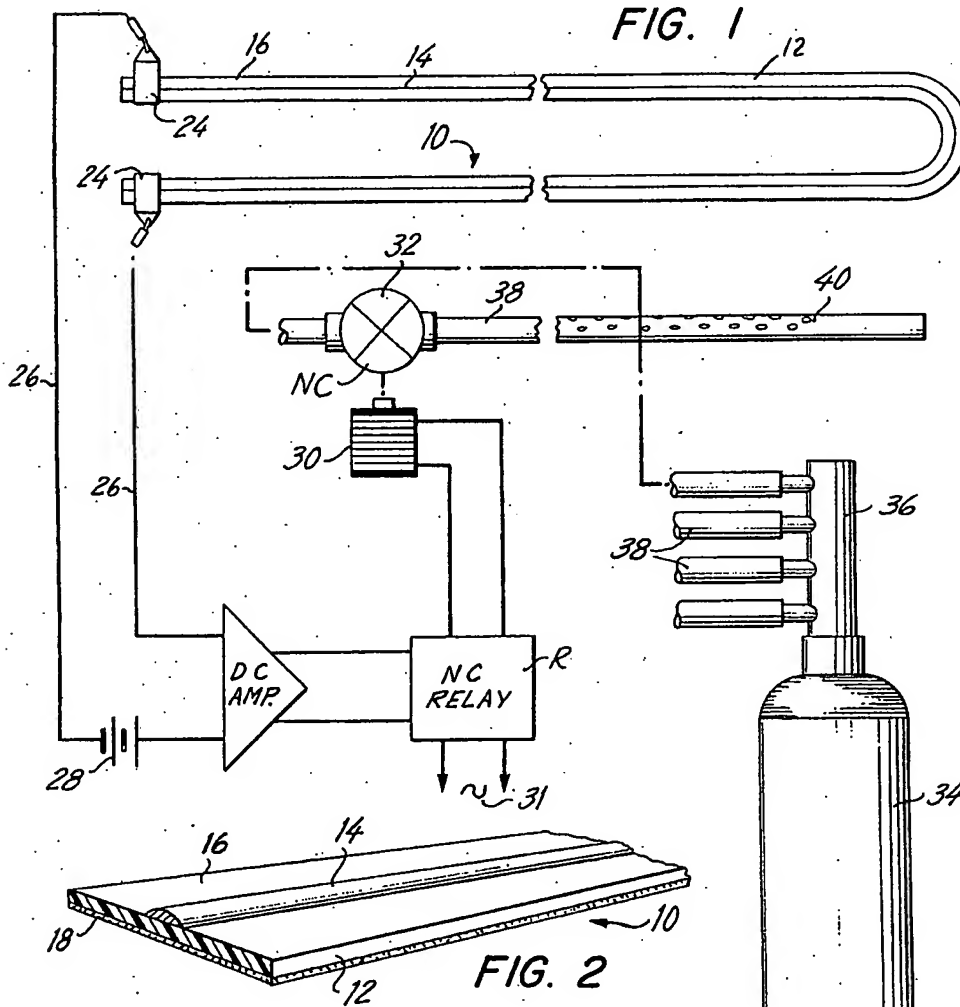
<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC INT. CL. 4 B32J: 5/16 U.S. CL. 265/101, 171; 425/203; 428/313.3, 325, 327		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
U.S.	264/101, 171      425/203; 428/313.3, 313.5, 313.9, 323, 325, 327	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b>		
Category <sup>*</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
Y,P	US, A, 4,748,061 (VESLEY) 31 MAY 1988 ENTIRE DOCUMENT	1-73
Y	US, A, 4,223,067 (LEVINS) 16 SEPTEMBER 1980. COLUMN 3, LINES 16-21.	1-73
Y	US, A, 4,098,945 (OEHMKE) 04 JULY 1978. ENTIRE DISCLOSURE.	1-73
Y	US, A, 4,065,532 (WILD) 27 DECEMBER 1977	46-73
Y	US, A, 3,985,348 (SKIDMORE) 12 OCTOBER 1976. ENTIRE COLUMNS 2 AND 3.	64-69
Y	US, A, 3,565,737 (LEFEVRE) 23 FEBRUARY 1971	70-73
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><sup>*</sup> Special categories of cited documents: <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
26 SEPTEMBER 1988	22 NOV 1988	
International Searching Authority ISA/US	Signature of Authorized Officer W. J. VANBALEN <i>W. J. VanBalen</i>	

Jan. 10, 1967

H. C. PELTIER

3,297,846

FUSIBLE FIRE SENSING TAPE FORMED OF METAL PARTICLES  
DISPERSED IN A FLEXIBLE PLASTIC BINDER  
Filed Sept. 22, 1964



INVENTOR  
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ATTORNEYS